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MYCOTAXON

VOLUME IX, 1979

COMPLETE IN TWO ISSUES
THE "STUNTZ FESTSCHRIFT" AND ONE QUARTERLY ISSUE
CONSISTING OF iv + 528 PAGES
INCLUDING FIGURES

QK
600
M992
v.9-10
1979-
1979/80

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FOR THE STUNTZ FESTSCHRIFT

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Guest Co-Editor

Published by
MYCOTAXON, LTD., P.O. BOX 264, ITHACA, NY 14850, USA
Printed in the United States of America

TABLE OF CONTENTS, VOLUME NINE

No. 1 June 12, 1979

A FESTSCHRIFT IN HONOR OF DANIEL E. STUNTZ

Contents.. 1
Preface... 2
Daniel E. Stuntz - A distinguished prefessor and friend, DAVID RAMON HOSFORD.. 3
On the Massariaceae in North America, MARGARET E. BARR........... 17
Notes on *Fayodia* ss. lato, HOWARD E. BIGELOW..................... 38
Limnoperdon, a cyphellaceous fungus with gasteroid basidia? GUSTAVO A. ESCOBAR & DENNIS E. McCABE........................... 48
The genus *Phellinus* (Aphyllophorales: Hymenochaetaceae) in western North America, R. L. GILBERTSON........................ 51
Synaptonemal complexes in the gametangia of *Sapromyces androgynus* (Leptomitales, Oomycetes), DAVID GOTELLI....................... 90
New and interesting taxa of *Russula* Pers. *ex* S.F. Gray occurring in Washington State, DARRYL W. GRUND.......................... 93
Neotype selection for *Agaricus asprellus* Fr., DAVID L. LARGENT.... 114
Collybioid genera in the Pacific Northwest, JOANNE WILLIAMS LENNOX 117
Filoboletus propullans, a new poroid agaric from Panamá, SUSAN D. LIBONATI-BARNES.. 232
Chrysoconia, a gasteroid member of the Coniophoraceae, DENNIS E. McCABE & GUSTAVO A. ESCOBAR.................................. 239
The contributors and Daniel Stuntz, DAVID L. LARGENT............. 243
Laccase and tyrosinase oxidation of spot test reagents, CURRIE D. MARR.. 244
Two new species and new records of *Tulostoma* from the Pacific Northwest, DENNIS M. OLIVER & DAVID R. HOSFORD................. 277
The genus *Suillus* in the western United States, HARRY D. THIERS... 285
The orders, families, and genera of hypogeous Ascomycotina (truffles and their relatives), JAMES M. TRAPPE................ 297
The stirps *Cohaerens* of *Marasmius*, ALEXANDER H. SMITH............ 341
The sections of *Coprinus* present in the western United States, FRED VAN DE BOGART.. 348
Index to Fungus and Lichen Taxa................................. 358

No. 2 July-September 1979

A monographic revision of the genus *Sclerotinia*, LINDA M. KOHN.... 365
Hypogeous ascomycetes in Alberta, Canada with two new North American records, R. M. DANIELSON............................. 445
Hypogeous fungi of Minnesota: *Genea anthracina* sp. nov., ELWIN L. STEWART & RUSSELL K. HEBLACK.............................. 451
Notes on mycological history. I. M.A. Curtis vs. a national herbarium, RONALD H. PETERSEN................................ 459
A new combination in the genus *Flagelloscypha* and a contribution to the identity of *Cyphella peckii*, R. AGERER.................. 464
Notes on hyphomycetes. XXXII. Five new aquatic species, R. C. SINCLAIR & G. MORGAN-JONES.................................. 469
Urédinales nouvelles de l'Himalaya, GUY DURRIEU.................. 482
Western fungi: a New Mexico *Psathyrella* in the *Cystidiosae* of subgenus *Homophron*, W. W. PATRICK, JR. & CHARLES BARROWS........ 493

Type studies in the genus *Peziza*. VIII-X. Species described by G. Massee, E. K. Cash, and F. J. Seaver, DONALD H. PFISTER...... 501
Notes on Corticiaceae (Basidiomycetes) IV, KURT HJORTSTAM & LEIF RYVARDEN.. 505
Notice: Mycological Nomenclature - Fossil Fungi.................. 520
Later starting point blues. I. *Monilia fructigena,* RICHARD P. KORF & LINDA M. KOHN.. 521

Author INDEX.. 523
Errata, Volumes 7, 8 & 9.. 524
Reviewers... 524
MYCOTAXON publication dates, 8(2) and 9(1)....................... 524
INDEX to Fungous and Lichen Taxa................................ 525

MYCOTAXON

AN INTERNATIONAL JOURNAL DESIGNED TO EXPEDITE PUBLICATION
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Volume IX June 12, 1979 No. 1

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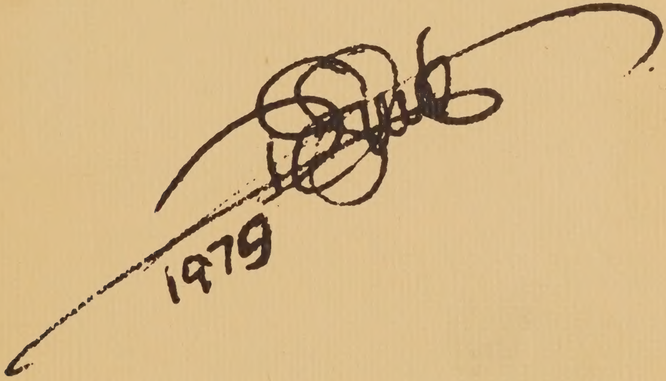

ISSN 0093-4666 MYXNAE 9(1) 1-364 (1979)

Library of Congress Catalogue Card Number 74-7903

Published quarterly by MYCOTAXON, Ltd., P.O. Box 264, Ithaca, NY 14850
For subscription details and availability in microform,
see inside back cover

CONTENTS

Contents 1
Preface 2
Daniel E. Stuntz - A distinguished professor and friend. DAVID RAMON HOSFORD 3
On the Massariaceae in North America .... MARGARET E. BARR 17
Notes on *Fayodia* ss. lato .... HOWARD E. BIGELOW 38
Limnoperdon, a cyphellaceous fungus with gasteroid basidia? GUSTAVO A. ESCOBAR AND DENNIS E. MCCABE 48
The genus *Phellinus* (Aphyllophorales: Hymenochaetaceae) in western North America .... R. L. GILBERTSON 51
Synaptonemal complexes in the gametangia of *Sapromyces androgynus* (Leptomitales, Oomycetes) .... DAVID GOTELLI 90
New and interesting taxa of *Russula* Pers. *ex* S.F. Gray occurring in Washington State .... DARRYL W. GRUND 93
Neotype selection for *Agaricus asprellus* Fr. .... DAVID L. LARGENT 114
Collybioid genera in the Pacific Northwest. JOANNE WILLIAMS LENNOX 117
Filoboletus propullans, a new poroid agaric from Panamá. SUSAN D. LIBONATI-BARNES 232
Chrysoconia, a gasteroid member of the Coniophoraceae. DENNIS E. MCCABE AND GUSTAVO A. ESCOBAR 239
The contributors and Daniel Stuntz .... DAVID L. LARGENT 243
Laccase and tyrosinase oxidation of spot test reagents. CURRIE D. MARR 244
Two new species and new records of *Tulostoma* from the Pacific Northwest .... DENNIS M. OLIVER AND DAVID R. HOSFORD 277
The genus *Suillus* in the western United States.... HARRY D. THIERS 285
The orders, families and genera of hypogeous Ascomycotina (truffles and their relatives) .... JAMES M. TRAPPE 297
The stirps *Cohaerens* of *Marasmius* .... ALEXANDER H. SMITH 341
The sections of *Coprinus* present in the western United States. FRED VAN DE BOGART 348
Index to Fungus and Lichen Taxa 358

Guest Editor: DAVID L. LARGENT

Guest Co-Editor: DAVID R. HOSFORD

PREFACE

The concept for this volume in honor of Daniel E. Stuntz was initiated during discussions at the AIBS meetings in Corvallis in 1975. Basically we felt that every one of Dan's students have had their lives personally and professionally enriched by Daniel. Therefore, we felt some expression of our gratitude should be presented to him and hopefully this volume which contains articles by his students as well as his professional colleagues serves such a purpose.

Our function in this endeavor was simply to initiate and coordinate this project. We hasten to point out that we did not act as editors but were responsible for compiling the finished papers, numbering the pages of the volume and completing the index. Contextual or editorial errors are the responsibility of each contributing author.

We would like to acknowledge our appreciation for the numerous ideas and suggestions from Dan Stuntz's many students, particularly in the formative stage of this project. We would also like to thank Dr. Richard P. Korf for his assistance and his cooperation in allowing *Mycotaxon* to function as the publishing outlet for this commemorative volume.

Finally, we would like to thank you, Dan Stuntz, for your encouragement, guidance and kindness. Stand proud, Dan, you have every right to do so.

DAVID LARGENT
Arcata, California

DAVID HOSFORD
Ellensburg, Washington

MYCOTAXON

Vol. IX, No. 1, pp. 3-16 June 12, 1979

DANIEL E. STUNTZ--A DISTINGUISHED PROFESSOR AND FRIEND

by
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Central Washington University
Ellensburg, WA 98926

An Apology:

I would like to confess that I gathered much of the following from Dr. Stuntz without his approval or knowledge. Several means were used, but the most productive and, perhaps, most subversive were the wine sessions we shared sporadically over the last thirteen years. I sincerely hope memory of what was said during those occasions was not influenced too greatly by the exquisite wines imbibed. If so, my apologies, Dr. Stuntz, but let me assure you that I will never forget the friendship and details of vintages we shared.

Daniel E. Stuntz was born in Milford, Ohio, but moved at an early age to Seattle, a move never regretted largely because of the hot, muggy summers which adversely effected his health as a child. The family lived in the beautiful Magnolia district overlooking the Puget Sound, a place which offered nearby woods and chilly, sparkling waters in which to play. Surviving a normal childhood, one tale of his youth particularly gives us a glimpse of his inventiveness. He and his cousin loved to experiment in the kitchen (likely, in secrecy). On one occasion they developed a most unusual concoction which he still gladly shares. It is called "Stuntz's All Service Spice" with the following recipe: take one tsp. of celery seed, one tsp. (±) of baking soda, and mix liberally with an adequate amount of vanilla extract to produce a "drinkable" slurry; serve, if you dare! Having tried this, you'll find that it is particularly useful as an emetic. In hindsight, these trial and error experiments must have helped "mould" him into the connoisseur we know today.

Daniel's interest in botany was influenced by his father's business in sugar cane. His father spent much time on plantations in Cuba and the southern United States and, at least once, took him to Cuba. Daniel vividly recalls this experience, particularly the processing of the canes and the futile attempts of rats trying to escape from the hopper of the sugar cane press. Today, he is mildly amused at the mentioning of "pure," unrefined cane sugar so popular with the "organic" generation. While his father was away during the school year, Daniel often stayed with his aunt in Seattle. In later years, his parents moved to Pateros in north central Washington where his father established a business processing apples into concentrate.

In 1931, Daniel enrolled at the University of Washington. His choice of forestry was apparently influenced to some degree by a family friend and occulist. He advised Daniel to consider forestry, presumably for reasons relating to Daniel's near-sightedness (reportedly, equivalent to 40X hand lens) and the supposed non-eyestraining, outdoor life-style of the forester. Although his freshman courses in forestry, physical sciences, math, and engineering design were far from an outdoor experience, he excelled in them. It was later in that year or the next that he took his first botany course on the fungi (as we all know, pronounced fun-gee). The course in general mycology, taught by Dr. J. W. Hotson, convinced him that he had chosen the wrong major. Seeking to correct his mistake, he met with Dr. Frye, the stern chairman of the botany department. Dr. Frye's first reply to his request to enter botany was, "Young man, I do not seem to remember what your aspirations are." Daniel cautiously made his aspirations clear and was accordingly accepted into the program. Needless to say, he had found his niche and, in 1935, received a Bachelor of Science degree in botany. Afterwards he commenced work on a Masters degree under the supervision of Dr. Hotson.

His interest in the taxonomy of agarics was sparked by Hotson, a rust specialist, who loved agarics but apparently had little time to do research on them. As an undergraduate, Daniel began collecting mushrooms and occasionally had the opportunity to meet visiting mycologists. One of the most memorable meetings was in 1935 with Alexander Smith. They collected in the Olympic Mountains together and became lifelong friends.

His choice of graduate thesis came about through an innocent attempt to key out a mushroom, with angular-nodulose spores, to the genus *Cortinarius*. Mildly frustrated, Dr. Hotson came to his rescue and gently suggested that he try *Inocybe*. Becoming aware of the horrendous number of unidentifiable *Inocybe* species, he bravely began a floristic survey. However, just before completing his thesis, he received an opportunity which abruptly changed his immediate plans. In 1937, Dr. Frye approached him with the possibility (he stressed 'possibility') that, if he would get a Ph.D. at Yale under the famous forest pathologist, John S. Boyce, he might be considered as a replacement for Dr. Hotson, whose health was rapidly failing. Fully aware of the shortage of academic positions at that time, he quickly applied to Yale and was accepted by Dr. Boyce.

In spite of New Haven, he quickly adjusted to Yale and a course of study in forest pathology under Boyce. For his doctoral thesis, he proposed to expand his work on *Inocybe*, particularly since he now had better access to North American types in eastern herbaria. Dr. Boyce received the idea enthusiastically but quickly proclaimed, "I don't know an agaric from a battleship." Undaunted, however, he began the monographic work. He gratefully recalls receiving taxonomic help from Alexander Smith who extended an invitation to visit and use the herbarium and mycological library at the University of Michigan. He accepted the offer and "slithered" by auto to Ann Arbor one Christmas recess. He completed his thesis and Ph.D. in 1940 and, in the same year, accepted Dr. Hotson's vacated position at the University of Washington.

Hired as an instructor in botany, he initially taught Forest Pathology, General Mycology, and a plethora of bread 'n' butter courses such as Economic Botany. His earlier apprenticeship as a graduate teaching assistant apparently prepared him well. In 1959, he was promoted to full professor and in 1974 received the honorary title of Distinguished Professor, an immense honor, considering the number of faculty he was chosen from and the number of students attending the University (approximately 2,400 and 35,000, respectively). His courses were always of the highest quality, providing a thorough background in historical and current developments and literature, and uniquely organized with original illustrations and taxonomic keys. Lectures were never flamboyant or pretentious, but instead eloquent presentations sprinkled with humorous comments (seemingly missed by all but the most attentive) and beautiful color drawings in chalk.

During his years at the University, he enlarged the mycology offerings to include: Basidiomycetes (excluding the Rusts and Smuts); Ascomycetes (excluding the Yeasts); Yeasts and Related Forms; and Rusts, Smuts, and Fungi Imperfecti. During his tenure, Dr. Howard Wisler joined the staff and a course in Phycomycetes was added. Therefore, due to Daniel's presence, the University of Washington became a major center for mycological training and research.

The assessment of the total influence of such a man is impossible, particularly while he is still actively working. Leaving the impossible undone, I will mention only some of his more obvious accomplishments. Notable is his legacy of mycologists (Fig. 1), many of whom are active in teaching and research. Those at universities are likewise producing a second generation of mycologists. Another important contribution that should be noted is his extensive work with the amateur. For years, he has taught evening and weekend mushroom identification courses (gratis). He revised and enlarged the popular field guide to northwest species, *The Savory Wild Mushroom*. In 1963, he helped organize, and still advises, the huge Puget

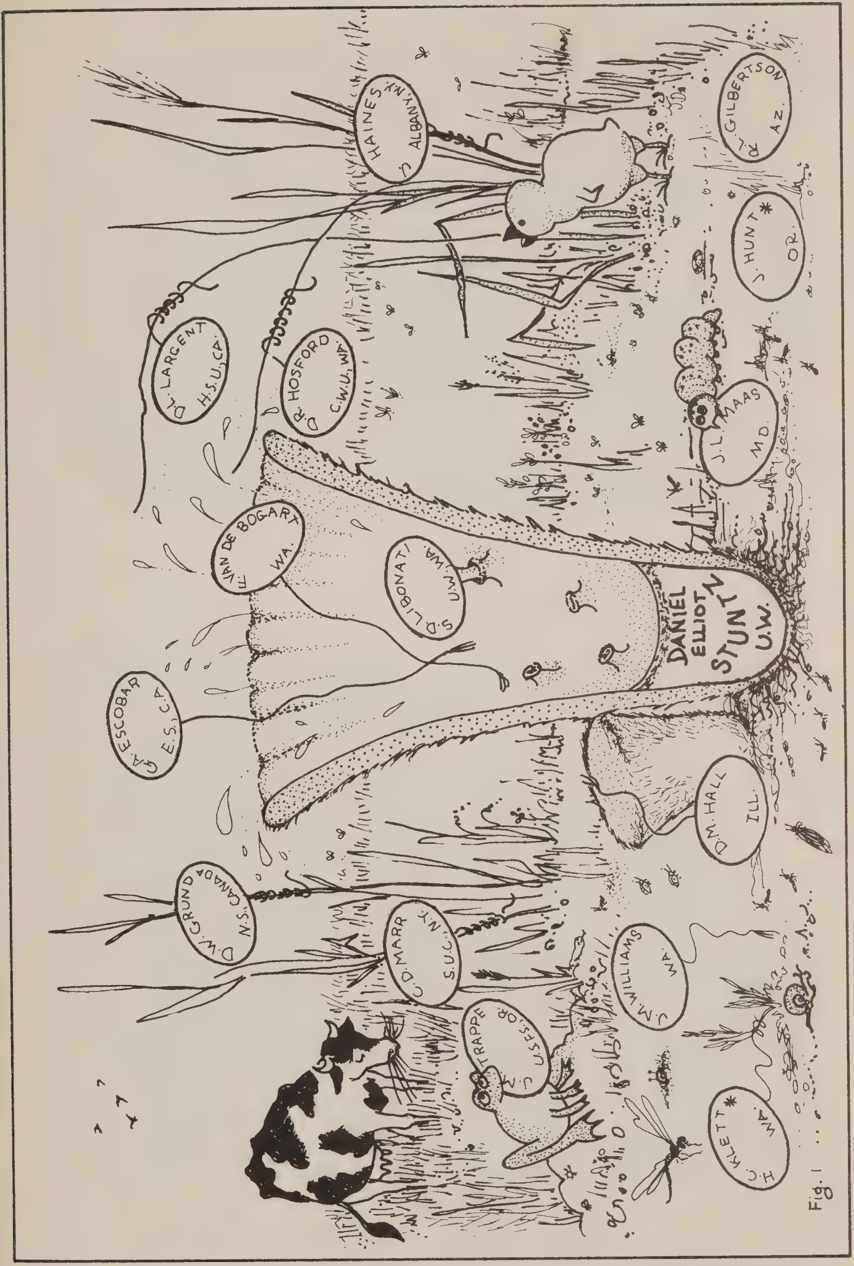
Sound Mycological Society. This organization has spawned at least a dozen smaller groups around the northwest.

In the 1967 edition of *American Men of Science*, he listed his specialties as morphology and taxonomy of Basidiomycetes and Ascomycetes. His published work in these areas, often co-authored, is extensive and covers a wide range of fungi. Over the years, he has steadfastly worked on *Inocybe*. Although he would be the last to admit it, progress on the monograph has been impeded by relatively heavy teaching responsibilities and large numbers of graduate students (Table I). Yet, he has published new species and has completed a manuscript (unpublished) on Sect. *Inocybium* (*sensu* Stuntz) of Subg. *Inocybium* (Earle) Singer. This section, at last count, includes 455 species, 29 varieties, and 18 forms, and contains only the smooth spored species with pleurocystidia. In the near future, he hopes to finish the "rough" spored section of Subg. *Inocybe* and publish the complete monograph.

Finally, I would like to list a few personal memories, many of which his students will certainly remember. I recall: his unselfish sharing of time and unbelievable patience; his incredible mycological library and facility with the literature; his occasional catnaps late at night or during seminars; his Louisiana coffee breaks; his legendary supply of exotic pastries (thanks for those scrumptuous maple bars, Dr. Stuntz!), luscious fruit, cheeses, breads, and beverages; his shopping excursions for pastries to supply the day's lab; his surprise gifts of expensive books, autographed in his unforgeable style (see cover); his occasional expressions of frustration (like ". . . 40,000 tons of inspissated Emeu . . . ."); his evenings at the symphony; the incessant ringing of his telephone during the mushroom season; his Friday Harbor excursions and the Stuntz Foray; and Friday evening wine sessions. Best, though, is the memory of having experienced the stimulating intellect of this gentle and kind man.

It is for these reasons, and many more, that his students and colleagues wish to dedicate this issue of *Mycotaxon* to Daniel E. Stuntz, now Professor Emeritus.

Figure 1. D. E. Stuntz's mycological descendants, restricted to those teaching in colleges and universities and/or active in research. For a more complete listing of graduate students refer to Table I.
*deceased


DANIEL ELLIOT STUNTZ U.W.
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D.R. HOSFORD C.W.U., WA.
J. HAINES ALBANY, N.Y.
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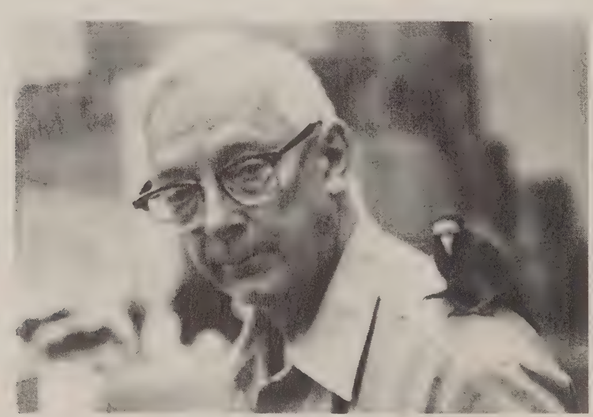
C.D. MARR S.U.C., N.Y.
J.M. TRAPPE U.S.F.S., OR.
J.M. WILLIAMS WA.
H.C. KLETT * WA.

Fig. 1

Left - Daniel, about 4 years old. Photo taken in Ohio.
Right - Daniel, about 10 years old. Photo taken in Seattle.



Dr. Stuntz and a roosting friend. Daniel has always been fond of pets. Many will remember Midge, his Boston terrier, and the many stray cats who wisely adopted him (his "cat" food is reportedly the best in Seattle). He has also been the recipient of a number of unusual pets: Caligula the *Iguana* (may he rest in Peace!); a nest of praying mantes; and an assortment of snakes and turtles.

From left to right, L. R. Hesler, A. H. Smith, R. Singer, and D. E. Stuntz. Photo was taken in the early 1950's at the University of Michigan Biological Station.

Left - Dr. Stuntz collecting in the field, 1950.
Right - Dr. Stuntz and friends arriving at Friday Harbor (San Juan Island) for a weekend of gourmet meals and mushroom collecting. About Nov. 1974.

Daniel Stuntz and his friend Albert Pilát, together in Seattle during the 1969 International Botanical Congress.

Dr. Stuntz examining an *Inocybe* at (typical) close range.

Dr. Stuntz relaxing in Oneonta, N. Y., just after the 1977 Peck Foray. Swinging with Gloria Hosford and Currie Marr.

Dr. Stuntz in his Johnson Hall laboratory, U.W., 1978.

Table I

GRADUATE DEGREES COMPLETED UNDER THE SUPERVISION OF DANIEL E. STUNTZ

1951 M.S.	Robert Lewis Gilbertson Department of Plant Pathology University of Arizona Tucson, AZ 85721	Polyporaceae of Flathead Lake region of western Montana
1951 M.S., Forestry	John Hunt Pacific Northwest Regional Experiment Station, Forest Service Portland, OR (Died 1959 en route to assume Dr. Boyce's position at Yale)	An investigation of two species of fungi associated with Bark-Beetles on Pacific Silver Fir
1957 M.S.	Harvard Lyman address unknown	The ontogeny of the laticiferous system of *Lactarius aurantiacus* (Fr.) Fries
1957 Ph.D., Forestry	James Martin Trappe Forestry Science Laboratory 3200 Jefferson Way Corvallis, OR 97331	*Cenococcum graniforme* - its distribution, ecology, mycorrhiza formation, and inherent variation
1962 M.S.	Darryl William Grund Department of Biology Acadia University Wolfville, N.S. Canada	*Pholiota* of Washington State
1962 M.S.	Hubert Cliffort Klett Department of Biology Olympic College Bremerton, WA 98310 (Died 1976)	A survey of the Tremellales of the Pacific Northwest

1963 M.S. Dennis Melvin Hall Department of Biology Northeastern Ill. University Bryn Mawr at St. Louis Chicago, IL 60625	A survey of the pileate Hydnaceae of western Washington
1963 M.S. Theodore Charles Hoffman Mason Lake, WA (deceased)	A survey of Boletaceae of Washington
1963 M.S. Bill Forgust Isaacs Tewa Enterprises Sante Fe, N.M. 87501	A survey of *Agaricus* in Washington, Oregon, and California
1964 Ph.D. Hurbert Clifford Klett Department of Biology Olympic College Bremerton, WA 98310 (Died 1976)	North American Species of *Exidia*
1964 M.S. John Lewis Maas Fruit Laboratory BARC-W Beltsville, MD 20705	A survey of the macrofungi on serpentine and non-serpentine soils in the upper Teanaway River Valley, Washington
1965 Ph.D. Darryl William Grund Department of Biology Acadia University Wolfville, N.S. Canada	A survey of *Russula* occurring in Washington State
1965 M.S. Phyllis Margaret Hicks College Biological Supply Bothell, WA	A taxonomic survey of *Peziza* in western Washington

1965 M.S.	Naoshi Nakamura Okinawa	A survey of *Amanita* in western Washington
1967 M.S.	Betty Ann Alder Bremerton, WA 98310	A survey of genus *Guepiniopsis* with comparison of genera *Guepiniopsis* and *Dacrymyces*
1967 M.S.	John H. Haines, Ph.D. New York State Museum Albany, N.Y. 12234	A survey of the genus *Dasyscyphus* and related genera in western Washington
1968 Ph.D.	Dennis Melvin Hall Department of Biology Northeastern Illinois University Bryn Mawr at St. Louis Chicago, IL 60625	A survey of the pileate Hydnaceae of western Washington
1968 Ph.D.	David Lee Largent Department of Biology Humboldt State University Arcata, CA 95521	*Leptonia* and related genera of the west coast with a preliminary revision of the Rhodophylloid fungi
1968 Ph.D.	Currie Daniel Marr Science-Biology Department State University College Oneonta, N.Y. 13820	*Ramaria* of western Washington
1971 Non-thesis Masters	R. L. Holman Seattle, WA	"A study of *Histoplasma* in the Pacific Northwest"
1971 Non-thesis Masters	Fred Van De Bogart, Jr. Seattle, WA 98133	A taxonomic survey of the coprophilous taxa of *Coprinus* (Agaricales) in western Washington

1972	Ph.D. David Ramon Hosford Department of Biological Sciences Central Washington University Ellensburg, WA 98926	*Rhizopogon* of the northwestern United States
1974	M.S. Gustavo A. Escobar Apartado Postal #05-50 San Salvador, El Salvador Central America	Algunos Hongos de El Salvador Tremellales, Thelephorales y Discomycetes
1975	Non-thesis Masters Carol Sue Davis Everett, WA	Studies on the Bird's Nest Fungi of Washington State
1975	Ph.D. Fred Van De Bogart Seattle, WA 98133	The genus *Coprinus* in Washington and adjacent western states
1975	Ph.D. Joanne Helen Williams (Lennox) Issaquah, WA 98027	The Collybioid fungi of western Washington
1978	Ph.D. Gustavo A. Escobar Apartado Postal #05-50 San Salvador, El Salvador Central America	Contribution towards a monograph of neotropical species of *Hymenochaete*
1979	Ph.D. (to be completed) Susan D. Libonati (Barnes) Department of Botany University of Washington Seattle, WA 98195	"Selected Pleurotoid genera of western Washington"

ACKNOWLEDGEMENTS

The author appreciates the editorial comments of Professor Curt A. Wiberg, C.W.U., and suggestions from his wife Gloria Beth. I'm also grateful to Fred Van De Bogart and Susan Libonati-Barnes for double-checking some of the facts. Finally, I wish to thank Julia Duskin for her delightful rendition of my original sketch (Figure 1) and Robert Gilbertson, Harry Thiers, Joanne Williams-Lennox, and Fred Van De Bogart for loaning some of the included photos.

MYCOTAXON

Vol. IX, No. 1, pp. 17-37 June 12, 1979

ON THE MASSARIACEAE IN NORTH AMERICA

MARGARET E. BARR

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Amherst, Massachusetts 01003

SUMMARY

The family Massariaceae of the Melanommatales comprises taxa with medium to large ascocarps, a peridium composed of numerous layers of small compressed cells, thick-walled bitunicate asci, trabeculate pseudoparaphyses, and large, symmetric, distoseptate ascospores. Six genera are recognized in the family and are distinguished by ascospore septation, perithecioid or cleistothecioid ascocarps or presence of stromatic tissues. *Dothivalsaria megalospora* with one-septate ascospores and *Aglaospora profusa* with three-septate ascospores have ascocarps grouped beneath stromatic tissues that form coarse sulcations at the substrate surface. Species of *Caryospora* and *Zopfia* produce one-septate ascospores that develop thin secondary septa near the tips. Cleistothecioid ascocarps are formed by species of *Zopfia*. The species of *Massaria* have three-septate ascospores; ascocarps are separate with or without clypeal tissues. Species of *Titanella* form many transverse and vertical septa in the ascospores.

In a forthcoming article, expanded from a poster presentation prepared for IMC2 in 1977, Barr (1979) presents a classification of the Loculoascomycetes. The families of Pleosporales in the classification of Luttrell (1973) or the suborder Pseudosphaeriineae of the Dothideales according to von Arx and Müller (1975) are rearranged and expanded into two orders (Barr, 1976); a key to families and notes on representative genera are given. It is my intention to enlarge on the outline with descriptions of genera and species of the various families known from temperate North America, even though the numbers of species and details of their distribution are incomplete at present. This contribution presents information on the family Massariaceae of the order Melanommatales.

The distinguishing features of members of the Massariaceae are: ascocarps large (500 μm or more diam), peridium of numerous compact layers of small cells, asci thick walled, pseudoparaphyses trabeculate, branched and anastomosing, embedded in a gelatinous matrix, ascospores large, symmetric, distoseptate, and usually surrounded by a gelatinous coating. Somewhat similar species whose peridia are coarsely pseudoparenchymatous, pseudoparaphyses cellular, and ascospores asymmetric are segregated into a parallel family belonging in the Pleosporales and will not be discussed here.

Massariaceae Winter in Rabenh. Krypt.-Fl. 1(2): 534. 1886.

Zopfiaceae Arnaud, Bull. Soc. Mycol. France 29: 259. 1913.

Ascocarps medium to large, perithecioid or cleistothecioid, globose or depressed or bases flattened and applanate, immersed, erumpent or almost entirely superficial; apex short papillate, rounded or sometimes compressed, at times papilla dehiscent leaving an excavated rounded pore, or entirely closed; peridium composed of compressed layers of small cells, usually broad but narrow and forming cephalothecoid plates in some taxa, with dark reddish or vinaceous brown pigment encrusted on walls of outermost cells; stromatic tissues sparse or well developed, forming at times a coarsely sulcate surface above ascocarps, grown together with substrate cells as pseudostroma at times, then often delimited by a dark marginal zone, clypeal in most species. Asci bitunicate, arising from base of locule, wall thick, often with broad blunt apical region surrounded by refractive ring, often less than eight spored; pseudoparaphyses trabeculate, narrow, distantly and inconspicuously septate, conspicuously branched and anastomosing above the asci, embedded in a gelatinous matrix. Ascospores large, symmetric, ellipsoid or fusoid, distoseptate in the majority of species, hyaline or brown, pigment in cell contents and/or in cell walls, contents often forming thick-walled endospores, one or three septate or muriform; wall smooth or roughened, usually surrounded by a gelatinous coating, at times forming appendages at tips of spores, at times drying down to form reticulated roughenings on spore surface.

Saprobic or weakly parasitic, on branches or roots of trees and shrubs, hard endocarps of fruits, culms of large monocots.

Anamorphic states poorly known; where known coelomycetous, conidia small, apparently spermatial.

Genera of Massariaceae

1. Ascospores one septate or secondary septa thin and near tips of ascospores 2
1. Ascospores three septate or muriform 4
   2. Ascocarps immersed, grouped and surrounded by stromatic tissues forming coarse sulcations at surface of substrate . . . . *Dothivalsaria*
   2. Ascocarps erumpent or superficial, separate, stromatic tissues if formed closely appressed to peridium 3
3. Ascocarps with papillate apex, opening by pore . . . . *Caryospora*
3. Ascocarps with rounded apex, without preformed pore, opening by splitting of peridium . . . . *Zopfia*
   4. Ascospores multiseptate, with both transverse and vertical septa; ascocarps immersed, erumpent or superficial, separate . . . . *Titanella*
   4. Ascospores transversely three septate; ascocarps immersed 5
5. Ascospore wall hyaline or pallid, contents as thick-walled endospores, brown, mid cells approaching length of end cells; ascocarps usually grouped and surrounded by stromatic tissues, often forming coarse sulcations at surface of substrate . . . . *Aglaospora*
5. Ascospore wall and contents either brown or hyaline, mid cells shorter than end cells; ascocarps usually separate, stromatic tissues as clypeal region at surface of substrate or closely appressed to peridium . . . . *Massaria*

Aglaospora de Not. Giorn. Bot. Ital. 2: 43. 1844.

Ascocarps large, immersed, several grouped and erumpent together, short beaked; stromatic tissues blackened and often forming coarsely sulcate tips above small group of ascocarps, intermixed with host cells around ascocarps and forming whitened areas, circumscribed by blackened marginal zones; peridium composed of numerous layers of compressed cells, darkened toward surface. Asci cylindric, bitunicate, with thick walls and broad shallow cytoplasmic protrusion in apex, surrounded by refractive ring, usually eight ascospore initials formed but typically four ascospores maturing; pseudoparaphyses trabeculate, narrow, branched and anastomosing in gelatinous matrix. Ascospores pallid or light brown with dark brown endospores, ellipsoid, symmetric, tapering to rounded tips, three distoseptate, endospores rhomboid (in mid cells) or conoid (in end cells), wall smooth, surrounded by gelatinous coating.

Weakly parasitic on woody branches.

Conidial state said to be *Cytispora leucosperma* Fr. (Tulasne and Tulasne, 1863).

Type and single species: *A. profusa* (Fr.) de Not.

Shoemaker and Kokko (1977a) provided a description of *A. profusa* as an unitunicate ascomycete. The peculiar ascus tip -- with a "shoulder like ridge near apex" (Shoemaker and Leclair, 1975) and the presence of a refractive ring surrounding this ridge of cytoplasm suggest unitunicate nature. However, the ascus apices of *A. profusa* and of the species of *Massaria* are quite similar in structure. The asci are not typically bitunicate, but in water mounts of fresh material the exoascus will break and the endoascus elongate so that I consider them to be bitunicate. A refractive ring surrounding the apical cytoplasmic protrusion is found elsewhere in the Loculoascomycetes, notably in species of *Leptosphaerulina, Pyrenophora* and *Wettsteinina*.

When isolated on agar medium, *A. profusa* grows slowly to form a colony of rose-tinged hyphae. The agar beneath a colony becomes darkened. After 1 yr in culture, large irregular stromatic masses of pseudoparenchymatous hyphae were produced but these remained sterile.

Aglaospora profusa (Fr.) de Not. Giorn. Bot. Ital. 2: 43. 1844. Figs. 1-3
Sphaeria profusa Fr. Syst. Mycol. 2: 392. 1823.
Valsa profusa (Fr.) Fr. Summa Veget. Scand. p. 411.1849.
Pseudovalsa profusa (Fr.) Winter in Rabenh. Krypt.-Fl. 1(2): 785. 1887.
Massaria profusa (Fr.) Petrak, Ann. Mycol. 39: 347.1941.
Sphaeria anomia Fr. Syst. Mycol. 2: 381. 1823.
Aglaospora anomia (Fr.) Lamb. Fl. Mycol. Belg. 2: 250. 1880.
Massaria anomia (Fr.) Petrak, Ann. Mycol. 21: 114. 1923.
Sphaeria amorphostoma Schw. Trans. Amer. Philos. Soc. II, 4: 201. 1832.
Sphaeria capitella Klotsch in Rabenh. Deutschl. Krypt.-Fl. 1: 182. 1844.
Aglaospora ocellata de Not. Giorn. Bot. Ital. 2: 43. 1844.
Massaria seiridia Berk. & Curt. Grevillea 4: 155. 1876.
Pseudovalsa irregularis (DC.) Schroet. in Cohn, Krypt.-Fl. Schles. 3(2): 445. 1897.
Aglaospora irregularis (DC.) O. Kuntze, Rev. Gen. Pl. 3(2): 441. 1898.

Ascocarps 600-1100 μm diam, immersed or occasionally erumpent in small groups, rarely separate, surrounded by yellow brown or dark brown pseudostromatic tissues mixed with substrate cells, stromatic tissues above ascocarps darkened, erumpent and often forming coarsely sulcate peaks over short beaks, stroma often delimited by a darkened marginal line around sides and base; peridium dark brown externally, paler toward interior, composed of numerous layers of compressed cells, 60-70 μm wide. Asci 180-200 x 18.5-28 μm, broadly cylindric, with refractive ring around broad apical protrusion of cytoplasm; pseudoparaphyses trabeculate. Ascospores 36-54(-60) x 13-15(-17.5) μm, ellipsoid, wall hyaline to light brownish, endospores dark brown, three distoseptate, not constricted at septa, primary septum median, secondary septa nearly median in each half, endospore thick walled at maturity, ascospore wall smooth, surrounded by narrow gelatinous coating.

On branches of *Robinia pseudacacia*.

Material examined: CANADA: Ontario: London, 24 Mar 1890, J. Dearness; USA: New Hampshire: Barr 3878; Massachusetts: Barr 5100, 5269, 5327, 6028, 6305, 6416; New Jersey: Ellis NAF 172; Kansas: Fungi Col. 1566 (all MASS). EUROPE: Herb. Barbey-Boissier 246, 643; D. Saccardo, Mycol. Ital. 1487 (NY).

Caryospora de Not. Micromyc. Ital. Dec. 9: 7. 1856.

Ascocarps large, dull black, erumpent superficial, base rounded or flattened and applanate, leaving circular black line in substrate when removed, separate, apex papillate, opening by broad pore; peridium carbonaceous or firm, composed of numerous layers of slightly compressed cells, pigment heavily encrusted externally, base narrower than sides. Asci relatively few from base of locule, oblong or inflated in middle, nearly cylindric at times, bitunicate, (one) two to eight spored; pseudoparaphyses trabeculate, numerous, narrow, branched and anastomosing above asci, in gelatinous matrix, extending into apical pore. Ascospores rich reddish brown to dark brown, often opaque in age, symmetric, broadly ellipsoid, tapering to pointed or rounded tips, often paler at tips, primary septum median, usually constricted, distoseptate (young), at times one or more secondary septa near one or both ends, with large globule in each cell, wall thick, surrounded by narrow gelatinous layer when young and this drying down to form reticulate or striate or irregular roughenings on surface.

Saprobic on woody substrates, decorticated wood, stony endocarps of fruits, woody stems or arborescent grasses.

Conidial states coelomycetous where known, species of *Asterostomella* according to von Arx and Müller (1975).

Type species: *C. putaminum* (Schw. ex Fr.) de Not.

Jeffers (1940) examined and briefly described the species of *Caryospora*. Of the North American species described in the genus, neither *C. cariosa* Fairman nor *C.minor* has distoseptate ascospores. The medium to large superficial ascocarps and light reddish brown, simply septate ascospores of these two species suggest a generic position in *Trematosphaeria* (Melanommataceae).

Species of *Caryospora*

1. Ascospores very large (over 50 μm long), becoming opaque in age 2
1. Ascospores medium large (up to 50 μm long), rich reddish brown but not usually opaque in age 3
    2. Ascospores one, two, four (rarely eight) per ascus, (50-)80-120(-150) x (35-)40-54(-65) μm, length:width ratio ca. 2:1; usually on peach endocarps . . . . *C. putaminum*
    2. Ascospores eight per ascus, (60-)85-117 x (20-)32-52(-57) μm, length:width ratio ca. 2.5:1; on rotting wood . . . . *C. callicarpa*

3. Ascospores with thickened secondary septa near tips, 32-50 x 15-20 μm; on canes of *Arundinaria* . . *C. langloisii*
3. Ascospores one septate, secondary septa if formed thin walled 4
    4. Ascospores 40-50 x 14-15 μm, length:width ratio ca. 3:1; on woody stems of *Artemisia* . . . . *C. striata*
    4. Ascospores 30-50 x (13-)17-20(-30) μm, length:width ratio ca. 2:1; on peach endocarps . . . . *C. minima*

Caryospora callicarpa (Currey) Nitschke in Fuckel, Symb. Mycol. p. 163. 1870. Fig. 4
Sphaeria callicarpa Currey, Trans. Linn. Soc. London 22: 321. 1859.

Ascocarps 800-1000 μm in diam or larger, bases applanate, conic, apex papillate, dehiscent and leaving large rounded pore; peridium firm, dark brown, composed of numerous layers of compressed cells. (Asci, according to literature: ca. 250 x 65 μm, eight spored.) Ascospores (60-)85-117 x (20-) 32-52(-57) μm, dark brown, opaque in age, broadly ellipsoid, tapering abruptly to elongate tips, tips somewhat paler than main body, primary septum median, not or slightly constricted, at times one or two septa in ends, wall thick, surrounded by a narrow gelatinous coating that dries down as irregular roughenings on surface.

Saprobic on decorticated decaying wood.

Material examined: USA: New York: Long Island, Zabriskie (Ellis Herb., NY); South Carolina: S. J. Smith 43991 (NY).

These collections are both overmature and asci are no longer evident. The ascospores are dark brown or opaque and the contents are not recognizable. Several ascospores had germinated, with germ tubes emerging from the thinner pallid tips. Ellis and Everhart (1892) provided ascospore measurements of 75-85 x 20-25 μm becoming 100-112 x 40-50 μm. The ascospores of *C. callicarpa* in European collections, as in those of *C. putaminum*, are smaller -- 60-75 x 28-32 μm according to Dennis (1978).

Caryospora langloisii Ell. & Ev. J. Mycol. 4: 79. 1888. Fig. 5

Ascocarps up to 1 mm diam, immersed beneath, raising and finally rupturing thin epidermal layer of cells, bases applanate, conic, apex short papillate; peridium firm, dark brown encrusted externally, paler toward interior, ca. 50 μm wide at base, up to 78 μm wide at sides. Asci 110-170 x 40-45 μm, broadly oblong, eight spored; pseudoparaphyses trabeculate. Ascospores 32-50 x 15-20 μm, rich reddish brown, ellipsoid fusoid, primary septum median, slightly constricted, secondary septa near each tip, not constricted, with one large globule in each cell, surrounded by narrow gelatinous coating, smooth, some showing wrinkling of surface especially at tips.

On dead canes of *Arundinaria* (probably *A. macrosperma* Michx.).

Material examined: USA: Louisiana: Point a la Hache

P.O., 27 Mar 1888, A. B. Langlois, Flora Ludoviciana 1238 (type, NY).

The secondary septa of the ascospores might suggest a species of *Massaria*, but the shape and position of septa, as well as the ascocarp, are typical of species of *Caryospora*.

Caryospora minima Jeffers, Mycologia 32: 561. 1940. Fig. 6

Ascocarps 495-700 µm diam, superficial, thickly scattered, base applanate, conic, apex bluntly papillate, rounded pore visible at maturity; peridium brittle, dark brown externally, paler toward interior, composed of numerous layers of compressed cells. Asci 150-180 x 35-50 µm, clavate cylindric, eight spored; pseudoparaphyses trabeculate. Ascospores 30-50 x (13-)17-20(-30) µm, rich brown, broadly ellipsoid, primary septum median, constricted, with one large globule in each cell, wall thickened, smooth.

On peach endocarps, *Prunus persica*, on the ground.

Material examined: USA: Maryland: Harrison's Orchards, Berlin, 6 Aug 1938, W. F. Jeffers (type, NY).

Jeffers (1940) obtained ascocarps in culture of this species, just as he did in *C. putaminum*. He observed that *C. minima* differed from *C. putaminum* in smaller sizes and in less tapered ascospores. The ascospores in the type material do not show additional septa at this time, but Jeffers described a septum in each tip.

Caryospora putaminum (Schw. ex Fr.) de Not. Micromyc. Ital. Dec. 9: 7. 1856. Figs. 7,8
Sphaeria putaminum Schw. ex Fr. Syst. Mycol. 2: 461. 1823.

Ascocarps 495-1000 µm or more in diam, superficial, scattered, base applanate, conic, apex papillate, dehiscent at maturity, leaving rounded pore; peridium reddish brown externally, paler toward interior, composed of numerous layers of compressed cells, up to 100 µm wide. Asci 125-260 x 50-70 µm, oblong, ellipsoid or clavate, usually less than eight spores maturing (one, two, three or four); pseudoparaphyses trabeculate. Ascospores (50-)80-120(-150) x (35-)40-54(-65) µm, reddish brown, dark brown, finally opaque except for pallid tips, broadly ellipsoid or biconic, primary septum median, constricted, occasionally with thin septa in the tips, one large globule in each cell, wall thick (3-4.5 µm wide), surrounded by gelatinous coating 8-12 µm wide, surface smooth or roughened with granular deposit that may be reticulate.

On peach endocarps, *Prunus persica*, on the ground.

Material examined: USA: Massachusetts: Barr 2672, 5301, 5524, 6213; South Carolina: Ellis NAF 898 (all MASS).

For European collections, Scheinpflug (1958) described ascospore dimensions as 40-70 x 20-24 µm, considerably smaller than those in North American collections.

Jeffers (1940) cultured *C. putaminum* and obtained ascocarps on a peachstone-malt-extract agar. The most favorable pH was between 5.0 and 6.0, optimum temperature was 25-28 C, and ascocarps formed in partial or complete darkness but were fewer in number in full light. Ascocarps originated as a small hyphal knot which was surrounded by a pseudoparenchymatous layer. After about 1.5 mo, larger cells were visible within the young ascocarp and soon after asci developed and extended into the pseudoparaphyses. Ascospores germinated by a germ tube from the pallid tips. Jeffers obtained spermogonia containing minute spermatia in culture; the spermatia did not germinate.

Caryospora striata (Niessl) Scheinpflug, Schweiz. Bot. Ges. Ber. 68: 368. 1958. Fig. 9
Amphisphaeria striata Niessl, Hedwigia 15: 117. 1876.
Trematosphaeria striata (Niessl) Holm, Symb. Bot. Upsal. 14: 159. 1957.

Ascocarps ca. 660 μm diam, nearly globose, immersed in substrate with broadly papillate apex erumpent; peridium firm, dark brown, composed of several layers of compressed cells, ca. 30 μm wide, thickened toward exposed apex. Asci 240 x 18-22 μm, eight spored; pseudoparaphyses trabeculate. Ascospores 40-50 x 14-15 μm, dark reddish brown, ellipsoid, primary septum median, constricted, no additional septa seen, contents with one large and one small globule in each cell, wall finely roughened.

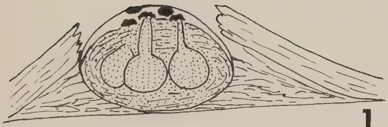
On *Artemisia tridentata*, large weathered stem.

Material examined: USA: Utah: Barr 6154A (MASS).

This collection is placed in *C. striata* with some reservations. The fungus is surely a species of *Caryospora* and it agrees quite well with descriptions of *C. striata* except for longer ascospores (Holm, 1957, gave 33-36 x 14-15 μm, Scheinpflug, 1958, 32-36 x 10-13 μm for European material of this species). *Caryospora striata* is known in Europe on wood of *Fraxinus* and *Quercus* and I have not seen it recorded from North America. My reservation lies in the disparate substrate and ecological situation of the Utah collection.

According to the description in North American Pyrenomycetes, p. 183, *Sphaeria sulcata* Ellis(*Melanomma sulcata* (Ell.) Ell. & Ev.), described from Utah on sagebrush, could be identical with my collection. Upon examination of NAF 1663 (MASS), this fungus proved to be a species of *Leptosphaeria* subgen. Syncarpella, related to *L. tumefaciens* (Ell. & Harkn.) Petrak by similarities of ascospores but differing from that species by possessing a large blunt, occasionally sulcate apex to the ascocarp.

Figs. 1-3. *Aglaospora profusa*: 1. Habit of ascocarps in stroma. 2. Ascospore. 3. Ascus apex showing refractive ring and uppermost ascospore. Figs. 4-9. Species of *Caryospora*: 4. *C. callicarpa*, ascospores. 5. *C. langloisii*, ascospores. 6. *C. minima*, ascospore. 7 and 8. *C. putaminum*, 7. Habit, 8. Ascospore. 9. *C. striata*, ascospores. Figs. 10-12. *Dothivalsaria megalospora*: 10. Habit of ascocarps in stroma. 11. Ascus apex. 12. Ascospores. Figs. 1, 7, 10, ca. X10. Standard line = 15 μm for remaining Figs.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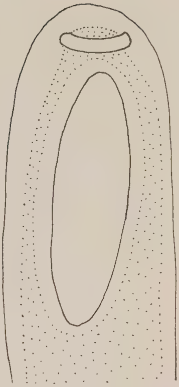
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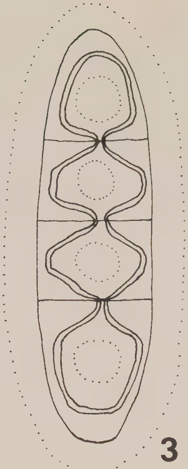
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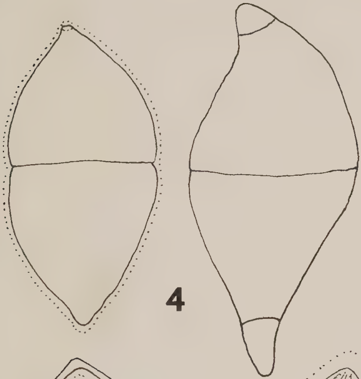
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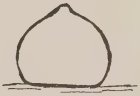
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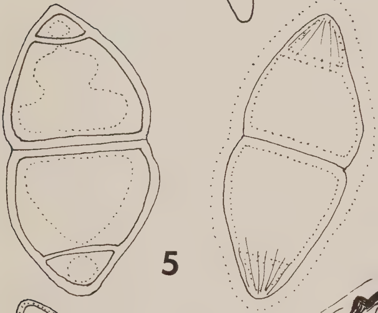
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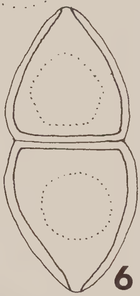
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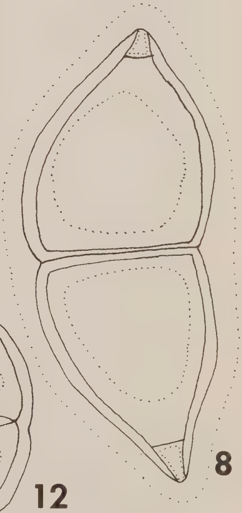
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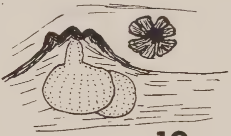
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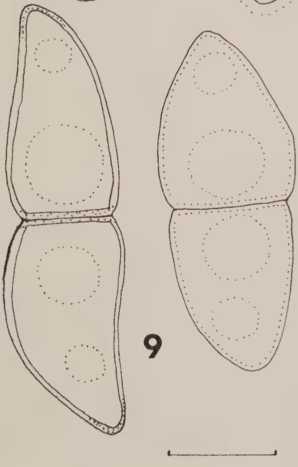
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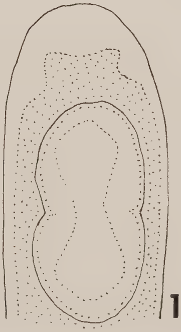
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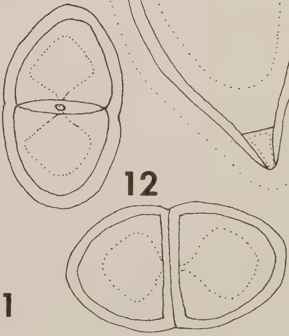
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Dothivalsaria Petrak, Sydowia 19: 283. 1966 (1965).

Ascocarps medium to large, globose or compressed, short beaked, immersed, usually several grouped together beneath blackened stromatic tissues that coalesce to form black, coarsely sulcate erumpent tips, pseudostroma intermixed with substrate cells, brownish around ascocarps; peridium brown externally, hyaline toward interior, composed of several layers of compressed cells, 12-30 µm wide. Asci cylindric, eight spored; pseudoparaphyses trabeculate, narrow, numerous, branched and anastomosing in gelatinous matrix. Ascospores brown, symmetric, broadly ellipsoid, ends rounded, septum median, not or slightly constricted, thickened, with one large rhomboid globule in each cell, wall thick, at times surrounded by narrow gelatinous coating.

On woody branches.

Type and single species: *D. megalospora* (Auersw.)Petrak

Dothivalsaria megalospora is a rare species that presents some problems in classification. Petrak (1966) created *Dothivalsaria*, based upon Kunze's exsiccati specimen (n. 364) of *Myrmaecium megalosporum*, stating that the genus was dothideal in contrast to *Massariovalsa sudans* (Berk. & Curt.) Sacc., which is diaporthaceous. While the habits of the two fungi are similar, they differ in stromatic tissues, paraphysoid tissues and details of ascospores. The genus *Massariovalsa* belongs in the Melanconidaceae of the Diaporthales (Barr, 1978) and is quite distinct from *Dothivalsaria*. None of the material of *D. megalospora* that I have seen was recently collected, but the asci are surely bitunicate, with thickened endoascus and a somewhat raised ridge of cytoplasm protruding in the apical region. Immature ascospores are distoseptate in aspect. The species resembles *Aglaospora profusa* by grouping of ascocarps surrounded by pseudostromatic tissues and especially by forming coarsely sulcate peaks of stromatic tissue erumpent from the substrate. The aspect of locules of both is comparable, while differences in ascospore pigmentation, shape and septation separate the two.

Dothivalsaria megalospora (Auersw.) Petrak, Sydowia 19: 283. 1966 (1965). Figs. 10-12

Valsaria megalospora Auersw. Lepizig Bot. Tauschver. 5. 1866.

Myrmaecium megalosporum (Auersw.) Niessl, Verh. Naturf. Ver. Brünn 12: 215. 1876.

Massariovalsa megalospora (Auersw.) Müller in Müller & von Arx, Beitr. Kryptogamenfl. Schweiz 11(2): 730. 1962.

Diatrype angulare Peck, Bot. Gaz. (Crawfordsville) 5:36. 1880.

Valsaria angularis (Peck) Sacc. Syll. Fung. 1: 745. 1882.

Ascocarps (220-)385-660 µm diam, usually in small circinate groups beneath blackened stromatic tissues, stromata up to 1.5 mm wide and deep, dark brown or blackened on surface as coarsely sulcate tips; peridium 12-30 µm wide. Asci 170-200 x 24-25 µm, eight spored; pseudoparaphyses trabeculate, extending into apical region. Ascospores 28-32(-42) x 13-15 µm, bright brown, septum median, wall smooth or sometimes finely punctate, at times surrounded by narrow gelatinous coating.

In woody branches of various dicotyledonous trees.

Material examined: USA: Vermont: on *Tilia americana*, New Haven, 17 May 1879, C. G. Pringle (type of *Diatrype angulare* Peck, NYS); Texas: on *Ungnadia speciosa*, Houston, H. W. Ravenel 65 (in specimen of *Parmentaria astroidea* Fee, MASS). EUROPE: J. Kunze, Fungi sel. exs. 364 on *Alnus*(BPI, two collections).

Massaria de Not. Giorn. Bot. Ital. 1: 333. 1844; Atti Sci. Ital. 1844: 485. 1845.
Saccothecium Fr., Summa Veget. Scand. 2: 398. 1849.

Ascocarps large, globose or depressed, immersed, apex erumpent, broadly papillate, stromatic tissues often forming a darkened clypeus above ascocarps or mixed with substrate cells as pseudostromatic tissues, at times circumscribed by blackened marginal zones; peridium firm, composed of numerous layers of compressed cells, darkly pigmented externally, paler toward interior. Asci cylindric or broadly oblong, bitunicate, apex with broad cytoplasmic plug that is often surrounded by a refractive ring, four or eight spored; pseudoparaphyses trabeculate, narrow, numerous, branched and anastomosing above asci in a gelatinous matrix. Ascospores narrowly or broadly ellipsoid, hyaline or brown, symmetric, distoseptate, primary septum median, not or slightly constricted, secondary septa closer to primary than to ends of ascospore, contents as lenticular (mid cells) or conoid (end cells) endospores, wall smooth, surrounded by gelatinous coating.

Saprobic or weakly parasitic on woody branches.

Conidial states where known coelomycetous; *Phoma* species (Tonolo, 1956).

Type species: *M. inquinans* (Tode ex Fr.) de Not.

Shoemaker and Leclair (1975) clarified the generic concept and provided synonyms and considerable other information about various species of *Massaria*. In the early compilation of descriptions, Ellis and Everhart (1892) included species that are now segregated into various genera in other orders of the Loculoascomycetes, e.g., *Asteromassaria, Splanchnonema* and *Trematosphaeria* in the Pleosporales, *Wettsteinina* in the Dothideales. These taxa are not considered here.

The four species of *Massaria* included in this treatment are quite similar in all respects. *Massaria inquinans* forms a well-developed clypeus and often blackened marginal zones delimiting the stromatic tissues. The ascospores tend to be wider than those of the other species. *Massaria xanthoxyli*, with eight-spored asci, is separated from *M. inquinans* by inconspicuous stromatic tissues and shorter ascospores. The two species with four-spored asci are also separated mainly on ascospore size.

Species of *Massaria*

1. Ascospores brown; asci usually eight spored 2
1. Ascospores hyaline, becoming yellowish or light or dull brownish in age; asci usually four spored 3
   2. Ascospores 46-66(-76) x 13-18 μm; blackened clypeal tissues inconspicuous or absent . . *M. xanthoxyli*
   2. Ascospores 64-96 x (12-)16.5-19(-27) μm; blackened clypeal tissues conspicuous . . . . . *M. inquinans*
3. Ascospores 48-64(-78) x 12-18 μm; blackened clypeal tissues present at times, sparse and indistinct at times . . . . *M. pyri*
3. Ascospores 73-90 x 13-21 μm; blackened clypeal tissues inconspicuous . . . . *M. lantanae*

Massaria inquinans ((Tode) Fr.) de Not. Giorn. Bot. Ital. 1: 333. 1844. Figs. 13-15

Sphaeria inquinans (Tode) Fr. Syst. Mycol. 2: 486. 1823. (*Sphaeria inquinans* Tode, Fungi Mecklenb. 2: 17. 1791.)

Sphaeria gigaspora Desm. Pl. Crypt. France Ed. 1, n. 2065. 1851 (Ed. 2, n. 1765; Ann. Sci. Nat., Ser. 3, 18: 363. 1852.)

Massaria gigaspora (Desm.) Berk. Grevillea 4: 156. 1876 (non Fuckel, 1873).

Massaria vomitoria Berk. & Curt. Grevillea 4: 155. 1876.

Ascocarps globose, 750-1500 μm diam, immersed, usually separate, at times two together, apex broadly papillate, protruding slightly beyond substrate surface; stromatic tissues forming blackened clypeus between periderm and wood, indistinct or pallid or darkened around ascocarps as pseudostroma, often forming dark marginal zone; peridium brown externally, paler toward interior, composed of numerous layers of compressed cells, 40-50 μm wide. Asci 210-350 x 40-44 μm, eight spored; pseudoparaphyses trabeculate. Ascospores 64-96 x (12-)16.5-19(-27) μm, brown, ellipsoid, three distoseptate, slightly constricted at median primary septum, with lens-shaped or conoid endospores, wall smooth, surrounded by gelatinous coating.

On branches of *Acer*, especially *A. saccharum*.

Material examined: USA: Maine: Barr 5799; Vermont: Barr 4197; Massachusetts: Barr 4130, 4905, 5187, 5264, 6000, 6031; New York: Ell. & Ev. NAF 2927; Shear's New York Fungi 152; Seaver, Ascomycetes and lower fungi 37; Washington: Fungi Col. 3140 (all MASS).

Shoemaker and Kokko (1977b) illustrated and described *M. inquinans* from Canadian material. *Massaria inquinans* is common on recently fallen sugar maple branches. After a year or more, decorticated branches bear large black circles, the remnants of ascocarp peridium and surrounding stromatic tissues.

The apex of the ascus usually has a refractive ring surrounding protruding cytoplasm, as does that of *Aglaospora profusa*. Ascospores of the two species are similar at first glance, but those of *A. profusa* have pigmented endospores and more nearly equal cells than those of *M. inquinans*.

Massaria lantanae (Otth) Shoemaker & Leclair, Canad. J. Bot. 53: 1583. 1975. Fig. 16

Cladosphaeria lantanae Otth, Mittheil. Naturf. Ges. Bern, 1868: 51. 1869.

Massaria plumigera Ell. & Ev. North Amer. Pyrenomycetes p. 404. 1892.

Massaria inquinans forma *viburni* Jaczewski, Bull. Herb. Boissier 2: 680. 1894.

Massaria plumigera var. *tetraspora* Dearn. & House, New York State Museum Bull. 188: 35. 1916.

(*Massaria gigaspora* auct. non (Desm.) Berk., non Fuckel).

Ascocarps 495-1500 µm diam, globose or depressed, immersed, separate, with broadly papillate apex protruding slightly beyond substrate surface; stromatic tissues forming a clypeus in periderm of substrate and extending along wood surface, loosely interwoven or indistinct around ascocarps; peridium dark brown, composed of numerous layers of compressed cells, 37-78 µm wide. Asci 140-285 x 32.5-45 µm, usually four spored; pseudoparaphyses trabeculate. Ascospores 73-90 x 13-21 µm, hyaline, becoming light yellowish or dull brown in age, narrowly ellipsoid, three distoseptate, not constricted at median primary septum, with lens-shaped or conoid endospores, surrounded by gelatinous coating.

On branches of species of *Corylus, Hamamelis, Viburnum.*

Material examined: CANADA: Ontario: Fungi Col. 4826. USA: New York: Shear's New York Fungi 356 (both MASS); Albany, 22 Feb 1915, H. D. House (type of *M. plumigera* var. *tetraspora* Dearn. & House, NYS); 5 June 1915 (NYS).

Shoemaker and Leclair clarified the synonymy of this species (1975) and Shoemaker and Kokko (1977c) described and illustrated Canadian specimens. The four-spored asci of both *M. lantanae* and *M. pyri* separate these two species from *M. inquinans* and *M. xanthoxyli*.

Massaria pyri Otth in Tulasne & Tulasne, Sel. Fung. Carp. 2: 237. 1863. Fig. 17

Cladosphaeria pyri (Otth in Tul. & Tul.) Otth, Mittheil. Naturf. Ges. Bern, 1868: 51. 1869 (as *C. pyri* Otth).

Massaria inquinans forma *pyri* (Otth) Jaczewski, Bull. Herb. Boissier 2: 680. 1894.

Pseudovalsa occulta Ell. Proc. Acad. Sci. Phila. 1895: 27. 1895.

Aglaospora occulta (Ell.) Farlow, Bibl. Index North Amer. Fungi 1(1): 166. 1905.

Massaria pruni Wehmeyer, Univ. Michigan Stud. Sci. Ser. 14: 131. 1941.

Ascocarps 600-900 µm diam, immersed, globose with broadly papillate apex protruding slightly beyond substrate surface; stromatic tissues forming narrow blackened clypeus, often connecting adjacent ascocarps, reddish brown or whitish pseudostromatic tissues around ascocarps; peridium brown externally, paler toward interior, composed of several layers of compressed cells, 24-40 µm wide, thickened toward apex. Asci 150-240 x 20-35 µm, four spored; pseudoparaphyses trabeculate. Ascospores 48-64(-78) x 12-16(-18) µm, hyaline becoming yellowish or light to dull brown in age, narrowly ellipsoid, three distoseptate, slightly constricted at median primary septum, with lens-shaped or conoid endospores, wall smooth, surrounded by gelatinous coating.

On branches of species of *Malus, Prunus, Pyrus.*

Material examined: CANADA: Ontario: Ell. & Ev. NAF 2613; Fungi Col. 1936. USA: New York: Shear's New York Fungi 153, 357; New Jersey: Ell. & Ev. NAF 97, 1954 (all MASS).

Shoemaker and Leclair (1975) provided the synonymy cited here.

Massaria xanthoxyli (Peck) Petrak, Ann. Mycol. 23: 138. 1925.
cf. Fig. 17

Massariella xanthoxyli Peck, Annual Rep. New York State Museum 46: 116. 1893.

Ascocarps 300-700 μm diam, globose with broadly papillate apex protruding slightly beyond substrate surface; stromatic tissues scarcely formed, as hyphae intermixed with cells of substrate; peridium brown externally, paler toward interior, composed of numerous layers of compressed cells, (20-)30-40 μm wide. Asci 100-190 x 33-53 μm, eight spored; pseudoparaphyses trabeculate. Ascospores 46-66(-70) x 13-18 μm, yellowish to dark brown, narrowly ellipsoid, three distoseptate, not or very slightly constricted at median primary septum, with lens-shaped or conoid endospores, wall smooth, surrounded by gelatinous coating.

On branches of species of *Morus, Ulmus, Xanthoxylum.*

Material examined: CANADA: Ontario: Ell. & Ev. NAF 2611 (MASS). USA: New York: Mechanicsville, May 1892, C. H. Peck (type, NYS); Alabama: Fungi Col. 1543 part (with *Massaria epileuca* Berk. & Curt. = *Trematosphaeria epileuca* (Berk. & Curt.) Shoemaker & Leclair) (MASS).

Petrak (1925) described the species in detail from a North Dakota collection. Shoemaker and Kokko (1977d) described and illustrated the fungus from Canadian specimens.

Titanella H. & P. Sydow, Ann. Mycol. 17: 36. 1919 (31 May).

Pleamphisphaeria v. Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 128: 576. 1919 (26 June).

Ascocarps large, dull black, immersed erumpent or superficial with rounded bases embedded in substrate, separate or

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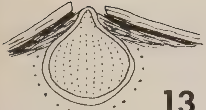
Figs. 13-17. Species of *Massaria*: 13-15, *M. inquinans*, 13. Habit of ascocarp. 14. Ascus apex. 15. Ascospore. 16. *M. lantanae*, ascospore. 17. *M. pyri (cf. M. xanthoxyli)* ascospore. Figs. 18-22. Species of *Titanella*: 18 and 19. *T. luzonensis*. 18. Habit of ascocarps. 19. Ascospore. 20 and 21. *T. macrospora*. 20. Habit of ascocarps. 21. Ascospore. 22. *T. pelorospora*, ascospore. Fig. 23. *Zopfia rhizophila*, ascospore. Figs. 13, 18, 20, ca. X10. Standard line = 15 μm for remaining Figs.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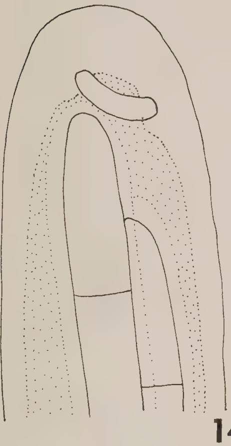
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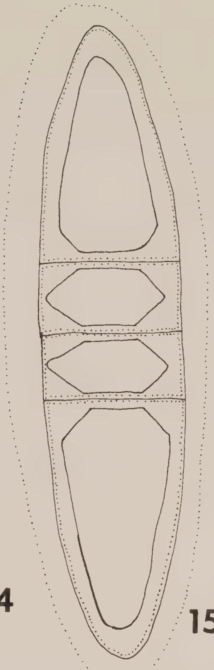
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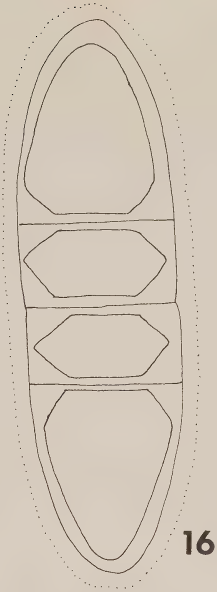
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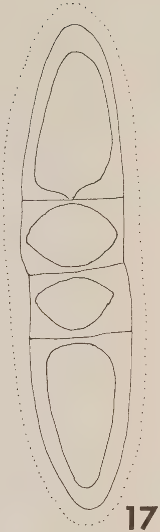
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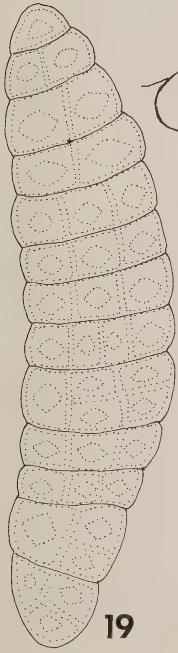
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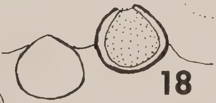
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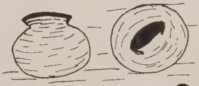
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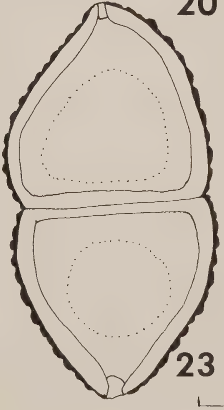
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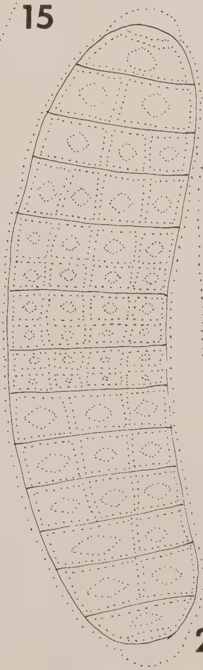
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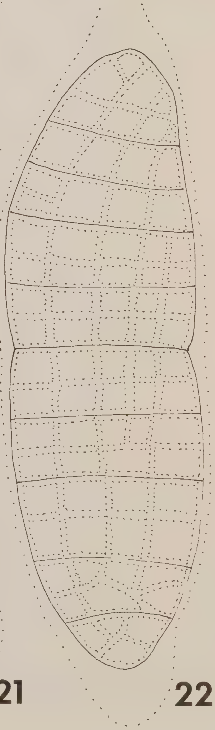
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connected by brown hyphae, apex papillate, rounded or compressed, opening by broad pore, excavated at times; peridium carbonaceous when ascocarps widely erumpent, firm when ascocarps immersed, composed of numerous layers of reddish to dark brown cells, pigment encrusted, heavily so on widely erumpent peridium, peridium narrowed toward base. Asci relatively few from base of locule, oblong or cylindric, bitunicate, two to eight spored; pseudoparaphyses numerous, narrow, branched and anastomosing above asci, extending into apical pore, in gelatinous matrix. Ascospores large, reddish brown or dark brown, elongate, cylindric or fusoid, tips rounded or tapered, often paler at tips, symmetric, (1-3-5-)17-23-septate, with one to five vertical septa, distoseptate in young stages, not obviously so when fully mature, often constricted at primary and secondary septa, with large globule in each cell, wall thick, surrounded by narrow gelatinous coating, surface smooth or finely rough.

Saprobic on woody substrates.

Type species: *T. luzonensis* (P. Henn.) H. & P. Sydow

The genus *Pleamphisphaeria* was also based on Hennings's species, and according to the dates imprinted on the issues of the two journals, is antedated by *Titanella* by less than one month.

Titanella has been relegated to synonymy with *Pleospora* by Clements and Shear (1931), with *Teichospora* by von Arx and Müller (1975), but differs from both genera in many respects. Fungi with large ascocarps and large copiously muriform ascospores, similar to species of *Caryospora* and *Massaria* in most features, find a position in *Titanella*. The presence of a large papillate apex is consistent in the species placed in this genus. However, the apex is rounded in the type species, compressed in *T. macrospora*, and variable even within a collection in *T. pelorospora*.

Species of *Titanella*

1. Ascospores ellipsoid fusoid, tapering to ends, relatively broad, (67-)80-117 x (18-)24-33 µm; ascocarp apex rounded or at times compressed . . . . *T. pelorospora*
1. Ascospores narrowly ellipsoid cylindric, ends rounded . 2
    2. Ascocarp apex rounded; ascospores 70-130 x (16-)18-26 µm . . . . *T. luzonensis*
    2. Ascocarp apex compressed; ascospores 80-110 x 20-26 µm . . . . *T. macrospora*

Titanella luzonensis (P. Henn.) H. & P. Sydow, Ann. Mycol. 17: 36. 1919. Figs. 18, 19

Julella luzonensis P. Henn. Hedwigia 47: 257-258. 1908.

Pleamphisphaeria luzonensis (P. Henn.) v. Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 128: 576. 1919.

Ascocarps up to 1.5 mm diam, globose, with very short broad apical papilla, becoming excavated and leaving rounded pore, immersed erumpent becoming nearly superficial, thickly scattered or in small groups; stromatic tissues slight, as brown hyphae extending into substrate, not forming clypeus; peridium firm, with dark brown narrow external layers and light brown inner layers, composed of numerous layers of compressed cells, ca. 50 µm wide at base and lower sides, thickened (up to 130-165 µm or more) over apex. Asci 195-260 x 30-65 µm, two, three, or four spored; pseudoparaphyses trabeculate. Ascospores 70-130 x (16-)18-26 µm, hyaline becoming vinaceous brown with paler end cells, narrowly ellipsoid cylindric, straight or often slightly curved, (10-)13-17 distoseptate, with one (two) vertical septa in all but end cells, slightly constricted at primary median and at several of secondary and tertiary septa, septa as well as walls thickened and darkened, endospores lenticular, wall smooth, surrounded by narrow gelatinous coating.

On dead unknown trees.

Material examined: PHILIPPINES: Luzon, Prov. Benguet, Mar 1904, A. D. E. Elmer n. 5937 (isotype, NY), 5957; Fungi Malayana, C. F. Baker 34 (NY).

Although this species lies beyond the range of the fungi recounted in this presentation, a description and figures are included for comparison with the species of *Titanella* that do occur in North America.

Titanella macrospora (Speg.) Barr, comb. nov. Figs. 20, 21

Lophiostoma macrosporum Speg. Michelia 1: 466. 1878.
Platystomum macrosporum (Speg.) Chesters & Bell, Mycol. Pap. 120: 46. 1970.

Ascocarps up to 1 mm or more in diam, globose, immersed erumpent, apex prominent, compressed, broad, with brown hyphae at sides forming a slight subiculum; peridium dark brown externally, paler toward interior, composed of numerous layers of small cells, 52-78 µm wide. Asci 275-350 x 50-60 µm, four or eight spored; pseudoparaphyses trabeculate. Ascospores 78-110 x 20-26 µm, yellowish brown to dark brown, narrowly ellipsoid cylindric, tapered slightly to rounded ends, end cells usually paler than main body, (7-9-)19 distoseptate, with one to three vertical septa in all but end cells, endospores lenticular or rhomboid, wall thick, dark, finely roughened at maturity, with traces of gelatinous coating.

On old wood of *Quercus*.

Material examined: USA: New Jersey: Newfield, Nov 1878 (as *Sphaeria cyploxia* n.s., Ellis ined., NY); Newfield, Oct 1893 (NY).

The New Jersey material of this species agrees well with the original description of the fungus from Italy and with Berlese's illustration (1890, Tab. IX, fig. 8). Chesters and Bell (1970) referred to Ellis's collection for their description of the species, and termed the ascospore septa "pseudosepta." Ellis, in notes accompanying the specimen, observed that the ascospores resembled those of *Ostreichnion americanum* (*O. asssafras* (Schw.) Barr) as indeed they do. The elongate ascocarps that open by a long slit in *O. sassafras* distinguish that species of the Lophiaceae from this one.

Titanella pelorospora (Dearn.) Barr, comb. nov.   Fig. 22

Amphisphaeria pelorospora Dearn. Mycologia 18: 247. 1926.

Ascocarps 500-1000 µm or up to 1.25 mm diam, widely erumpent, globose with rounded bases immersed in wood tissues, apex papillate, rounded or at times compressed; peridium brittle and carbonaceous when free from periderm, dark brown externally, paler toward interior, composed of numerous layers of small compressed cells, 40-60 µm wide if covered by remnants of periderm, up to 90-165 µm wide when free from periderm. Asci (130-)260-400(-550) x 32-54 µm, eight spored or less; pseudoparaphyses trabeculate. Ascospores (67-)80-117 x (18-)24-35 µm, light brown to reddish brown, ellipsoid fusoid, tapering to ends, (1-3-5-)11-23 septate, with three to five vertical septa, not in end cells or as Y-shaped septa, constricted at median primary septum, endospores rhomboid or lenticular, wall thick, smooth or finely roughened, surrounded by gelatinous coating that may be elongated over ends.

On bark of woody plants.

Material examined: CANADA: Quebec: *Betula* sp., Hull, 28 Apr 1891, Macoun, Canadian Fungi 78 (NY, two collections, as *Caryospora callicarpa*, *Trematosphaeria callicarpa*). USA: New York: *Liriodendron tulipifera*, Greenport, Long Island, 14 Mar 1924, R. Latham 1898 (NYS, as *Caryospora callicarpa*); *Nyssa*, Greenport, 27 Apr 1933, R. Latham 7631 (DAOM ex Dearness Herb., as *Amphisphaeria pelorospora*); New Jersey: *Nyssa*, Ell. & Ev. NAF 3012 (MASS, NY, as *Amphisphaeria papilla)*.

Dearness (1926) described the ascospores of *Amphisphaeria pelorospora* as "brown, 1-septate, constricted, biconic, 27-105 x 30-33 µ." The material studied from Dearness's herbarium (authentic but not type specimen) was a slide prepared and sent me by Dr. S. J. Hughes; the ascospores agree precisely with the description except that many septa are formed. True, the primary septum is darkened and constricted and most conspicuous, but even under low magnifications the additional septa are obvious. Dearness noted that *A. pelorospora* seemed to be the same as Ellis & Everhart's NAF 3012 of *A. papilla*, but that the description of that species (Ellis and Everhart, 1892, p. 178) differed by ascospores described as hyaline and 30-50 x 15-18 µm. The fungus on the copies of NAF 3012 that I examined is identical with Dearness's species. *Amphisphaeria papilla* (Schw. ex Fr.) Sacc. appears to be a different fungus entirely, both from Ellis and Everhart's (1892) concept as well as from NAF 3012. Their concept, according to the description and to a collection on white oak, Newfield, New Jersey, 6 Jul 1890 (NY) is of a hyaline-spored species that is referrable to the genus *Acrocordia*. A second collection from the Ellis herbarium, again from white oak, Newfield, Oct 1893 (NY) also bears this fungus. The brown spores that Ellis noted on the label of this collection belong to *Titanella macrospora*; the ascocarps are larger than those of the species of *Acrocordia* and have the apices compressed. Ellis (1896) examined Schweinitz's specimen of *Sphaeria papilla* and found brown, uniseptate ascospores, 25-32 x 8-12 μm (presumably a species of *Amphisphaeria*). Nonetheless, Ellis still referred the Newfield specimens to *Sphaeria papilla* Schw.

Zopfia Rabenh. Fungi Eur. n. 1734. 1874.

Ascocarps medium to large, black, erumpent superficial, globose, cleistothecioid; peridium composed of cephalothecoid plates of pseudoparenchymatous cells separated by pallid thinner areas, in section peridium composed of few layers of compressed cells, dark brown with vinaceous tinge. Asci bitunicate, broadly ovoid, few from base of locule, eight spored or less; pseudoparaphyses trabeculate. Ascospores reddish brown or dark brown, finally opaque, broadly ellipsoid, tapered to blunt ends, ends often pallid, symmetric, primary septum median, constricted, thin-walled secondary septa near each end, each cell containing a large globule, wall and primary septum thickened and dark, surface smooth or coarsely verrucose.

Type species: *Zopfia rhizophila* Rabenh.

Zopfia rhizophila seems very similar to *Caryospora putaminum*. The main differences are in the ascocarps of the two: those of *Caryospora* have an apical pore and firm, carbonaceous peridium whereas those of *Zopfia* have no apical opening mechanism and a cephalothecoid peridium. The genus is regarded in a restricted sense in this study, not in the broad sense of Hawksworth and Booth (1974). My interpretation of cleistothecioid forms places them at the ends of developmental lines. The ascospores of the various cleistothecioid taxa provide the best clue to their affinities (von Arx, 1971) and those of *Zopfia rhizophila* are certainly similar to those of species of *Caryospora*.

Zopfia rhizophila Rabenh. Fungi Eur. n. 1734. 1874. Fig. 23

Ascocarps globose, 485 μm or larger in diam, dark vinaceous brown; peridium firm, thin, ca. 15 μm wide near base, up to 30 μm wide above, composed of cephalothecoid plates separated by pallid cells. Asci 130-180 x 78-110 μm, usually less than eight spored; pseudoparaphyses trabeculate. Ascospores 48-75(-95) x 25-45(-50) μm, reddish brown to dark brown, finally opaque, broadly ellipsoid, tapering to narrow blunt ends, primary septum median, constricted, secondary septa inconspicuous at ends of cells, wall coarsely verrucose.

On roots of *Asparagus officinalis*.

Material examined: USA: Massachusetts: Barr 6395 (MASS).

Uecker (1977) provided a detailed description and illustrations of development and cytology of this species. He discussed the significance of the cephalothecoid peridium, as did Hawksworth and Booth (1974).

Zopfia albiziae Farr (Amer. Midl. Naturalist 71: 363. 1964) was described from roots of *Albizia lebbek* from Texas. The ascocarps are up to 1 mm diam, superficial, gregarious, black, wrinkled reticulate on the surface; peridium is up to 115 μm wide. The evanescent asci, 135-140 x 60-65 μm are pseudoparaphysate. The ascospores are 90-135 x 50-73 µm, ellipsoid rhomboid, black at maturity, one septate, scarcely constricted, with apiculate ends and slightly tuberculate walls. Farr (1964) was not able to obtain ascocarps in culture, nor was a conidial state formed.

Acknowledgments

I am indebted to the curators of herbaria cited in the text for loan of specimens in their keeping. In particular I thank C. T. Rogerson for reviewing the manuscript and S. J. Hughes for providing a slide from a Dearness collection.

Literature Cited

Arx, J. A. von. 1971. Testudinaceae, a new family of Ascomycetes. Persoonia 6: 365-369.

__________, and E. Müller. 1975. A re-evaluation of the bitunicate Ascomycetes with keys to families and genera. Stud. Mycol. Baarn 9: 1-159.

Barr, M. E. 1976. Perspectives in the Ascomycotina. Mem. New York Bot. Gard. 28: 1-8.

__________. 1978. The Diaporthales in North America with emphasis on *Gnomonia* and its segregates. Mycol. Mem. 7: 1-232. J. Cramer, Lehre.

__________. 1979. A classification of Loculoascomycetes. Mycologia 71: in press.

Berlese, A. N. 1890. Icones Fungorum. Fasc. 1 (Pars I): 1-28, XVII pl.

Chesters, C. G. C., and A. Bell. 1970. Studies in the Lophiostomataceae Sacc. Mycol. Pap. 120: 1-55.

Clements, F. E., and C. L. Shear. 1931. The genera of fungi. H. W. Wilson Co., New York. 496 p.

Dearness, J. 1926. New and noteworthy fungi--IV. Mycologia 18: 236-255.

Dennis, R. W. G. 1978. British Ascomycetes. J. Cramer, Lehre. 455 p.

Ellis, J. B. 1896. Notes on some specimens of Pyrenomycetes in the Schweinitz Herbarium of the Academy. Proc. Acad. Nat. Sci. Phila. for 1895, 47: 20-31.

__________, and B. M. Everhart. 1892. The North American Pyrenomycetes. Newfield, N.J. 793 p.

Farr, M. L. 1964. Mycological notes. III. New taxa, combinations, host and locality records. Amer. Midl. Naturalist 71: 363-368.

Hawksworth, D. L., and C. Booth. 1974. A revision of the genus *Zopfia* Rabenh. Mycol. Pap. 135: 1-38.

Holm, L. 1957. Études taxonomiques sur les Pléosporacées. Symb. Bot. Upsal. 14(3): 1-188.

Jeffers, W. F. 1940. Studies on *Caryospora putaminum*. Mycologia 32: 550-566.

Luttrell, E. S. 1973. Loculoascomycetes. Chapter 7, Pp. 135-219. In: The fungi. Vol. IVA. Eds., G. C. Ainsworth, F. K. Sparrow, and A. S. Sussman. Academic Press, New York.

Petrak, F. 1925. Mykologische Notizen. VIII. 495. Über *Massariella xanthoxyli* Peck. Ann. Mycol. 23: 137-138.

__________. 1966 (1965). Über *Valsaria megalospora* Auersw. und die Gattung *Massariovalsa* Sacc. Sydowia 19: 279-283.

Scheinpflug, H. 1958. Untersuchungen über die Gattung *Didymosphaeria* Fuck. und einige verwandte Gattungen. Schweiz. Bot. Ges. Ber. 68: 325-385.

Shoemaker, R. A., and E. G. Kokko. 1977a. *Aglaospora profusa*. Fungi Canadenses No. 101.

__________, and __________. 1977b. *Massaria inquinans*. Fungi Canadenses No. 104.

__________, and __________. 1977c. *Massaria lantanae*. Fungi Canadenses No. 105.

__________, and __________. 1977d. *Massaria zanthoxyli* (sic). Fungi Canadenses No. 106.

__________, and P. M. Leclair. 1975. Type studies of *Massaria* from the Wehmeyer collection. Canad. J. Bot. 53: 1568-1598.

Tonolo, A. 1956. Richerche colturali su alcune specie della famiglia delle Massariaceae. Phytopathol. Z. 26: 131-142.

Tulasne, L.-R., and C. Tulasne. 1863. Selecta Fungorum Carpologia. Vol. II. Paris. 319 p, 34 pl.

Uecker, F. A. 1977. Development and cytology of *Zopfia rhizophila*. Bot. Gaz. (Crawfordsville) 138: 420-427.

MYCOTAXON

Vol. IX, No. 1, pp. 38-47 June 12, 1979

NOTES ON *FAYODIA* SS. LATO

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In Singer's (1975) account of *Fayodia*, the genus is separated into four subgenera: Fayodia, with *F. bisphaerigera* (Lange) Kühner, the type of the genus, *F. tetrasphaerigera* Sing., *F. tenuisperma* Sing., *F. anthracobia* (Favre) Kühner & Romagnesi; Myxomphalia, with *F. maura* (Fr.) Sing., *F. invita* (Karst.) Sing., *F. marthae* Sing. & Clemencon; Heterosporula, with *F. pseudoclusilis* (Joss. & Konr.) Sing., *F. striatula* (Kühner) Sing., *Collybia albidula* Pat.; Clemenconia with *F. deusta* Sing. & Clemencon. *Fayodia campanella* Horak and *F. xerophila* Luthi & Röllin also should be included, both appearing to belong to subgenus Heterosporula. An important change in nomenclature must be noted too: Bresinsky and Stangl (1974) have determined that the correct name of *F. bisphaerigera* is *F. gracilipes* (Britzelmayr) Bsky. & Stangl.

The unique nature of the spore wall of *Fayodia gracilipes* has been observed under the light microscope by many investigators, and photomicrographs of the walls have been made with use of the electron microscope by Besson (1969) and Pegler and Young (1971). The spores are a distinct type in the Tricholomataceae, and have to be a critical diagnostic character of *Fayodia*. Singer (1975, p. 404) also has emphasized: "The fine structure of the spore wall is the ultimate diagnostic concept which infallibly separates this genus from all other genera of the Myceneae." I endorse this view enthusiastically, but add that it must be the fine structure of the spores of *Fayodia gracilipes* which has to be emphasized in the generic diagnosis. At least some taxa of *Fayodia ss. lato* do not have the same spore type and these taxa are heterogeneous elements which should be placed in other genera. The spores of *F. striatula* and *F. maura* are quite unlike those of *F. gracilipes* as shown by Figs. 3 and 4. Of course it can be argued that a difference in spore character is only worthy of emphasis at a subgeneric level, yet other genera in the Tricholomataceae have been emended freely in modern taxonomy to exclude elements which have divergent spore characters. There are a few cases (e.g., *Clitocybe*) where it can be demonstrated that there is an evolutionary sequence represented by types of spore ornamentation, but in *Fayodia* there seem to be no connections between the spore types of *F. maura* and *F. striatula* and *F. gracilipes*.

Myxomphalia Hora has been established already, and the SEM study of the spore surfaces of *M. maura* verifies the merits of its segregation. The genus *Stachyomphalina* is proposed in this paper to accommodate *F. striatula*. It has not been possible to examine all the species listed for *Fayodia*, but most in subgenera Heterosporula, Myxomphalia, and Clemenconia probably will require segregation after the surfaces of the spores are studied.

Fayodia alutacea Bigelow, sp. nov. Figs. 1, 2

Pileus usque ad 15 mm latus, pallido-alutaceus et striatus (udus), hygrophanus, albidus et opacus (decolores), convexus, glaber, levis. Odor rancido-spermaticus. Lamellae pallido-alutaceae, adnatae tum decurrentes, latae, subdistantes vel distantes. Stipes usque ad 35 mm longus, 1-2 mm crassus, pallido-alutaceus, solidus, glaber. Sporae (7.5-)8-11 µm diam, globosae vel interdum subglobosae, parietes similis *Fayodiae bisphaerigerae*, ectosporae amyloidae aliter inamyloidae. Basidia bisporae. Cheilocystidia plus minusve cylindrica. Hyphae fibuligerae. Carpophori gregarii. In solum.

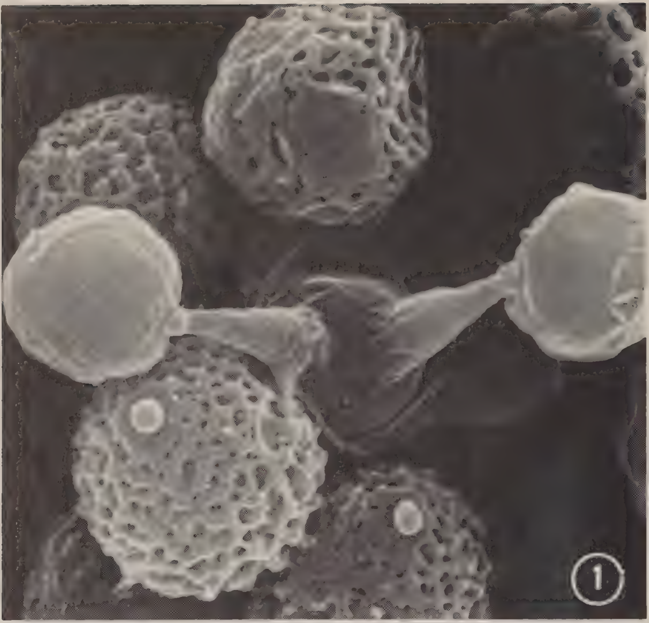
Holotypus legit H. E. & M. E. Bigelow (H. E. Bigelow, n. 13814, MASS); prope Stowe, Lamoille Co., Vermont, USA; 1 September 1964.

Pileus up to 15 mm broad; pale alutaceous when moist, whitish faded; convex, with a striate margin when moist, opaque when faded; surface glabrous, smooth, hygrophanous; context thin, brittle, concolorous with pileus surface. Odor rancid-spermatic when crushed. Taste not known.

Lamellae pale alutaceous (not fading with pileus); adnate to short decurrent, broad, subdistant to distant, edges fimbriate in places (under 10X).

Stipe up to 3.5 cm long, 1-2 mm thick, equal; pale alutaceous (not fading with pileus); solid, brittle, surface glabrous.

Spores (7.5-)8-11 µm diam, globose, or sometimes subglobose in lateral view, wall three layered: ectosporium smooth, amyloid, acyanophilic, discontinuous (at least in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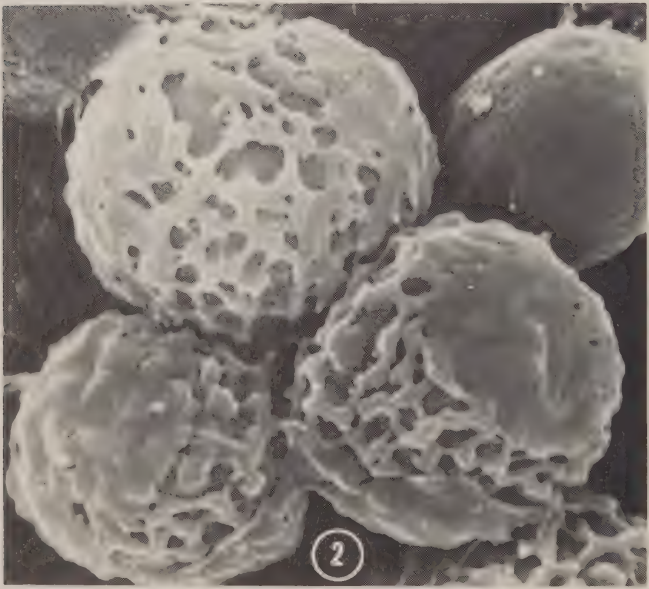
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revived material); mesosporium appearing echinulate in side view, more or less reticulate in face view, inamyloid, cyanophilic; endosporium smooth next to cell contents, inamyloid, cyanophilic. Basidia 24-30 x 6.5-9 µm, 2-spored, sterigmata up to 7 µm long. Cheilocystidia scattered, 30-60 µm long, 5-10 µm broad, more or less cylindric, sometimes slightly swollen in mid portion or basal portion, walls smooth, hyaline, thin. Pileus hyaline in KOH, surface a very thin gelatinous pellicle in KOH, cutis thin, of cylindric hyphae 3.5-7(-10) µm diam, walls smooth, thin; context hyphae cylindric or somewhat inflated, 10-15 µm diam, walls thin and smooth. Hymenophoral trama of parallel hyphae, cylindric near subhymenium, 3.5 µm diam, mediostratum of inflated or broad cylindric hyphae, 10-20 µm diam, walls thin and smooth. Clamp connections present.

Gregarious. On wet soil of drainage slope in mixed woods. Known only from the type collection.

This species differs from the others in subgenus Fayodia by the pale colors and rancid-spermatic odor. The microscopic characters are mostly not too different from those of *Fayodia gracilipes*, although descriptions of this species in the literature do not always include the presence of cheilocystidia. One interesting feature of the spores of *F. alutacea* is that the amyloid ectosporium is ruptured in the mature spores (Figs. 1, 2). This is not an artifact produced by the preparation of the spores for observation under the scanning electron microscope though, as the same discontinuous layer can be seen on spores which are only in Melzer's reagent or Cotton blue. Possibly the initial drying of the basidiocarps induced the rupturing of the ectosporium. Smith (1947; fig. 55, n. 7) has illustrated this phenomenon in *Fayodia gracilipes* in his drawing of the spores. Besson's (1969) electron photomicrographs also show a discontinuous ectosporium.

Stachyomphalina Bigelow, gen. nov.

Habitus mycenoideus vel omphalioideus. Pileus hygrophanus, pallido-brunneus vel fumosus et striatus (udus), sordido-bubalinus vel pallidus et opacus (decoloris); convexus demum planus, tandem plus minus ve depressus; glaber. Caro tenuissimis. Lamellae albidae vel sordido-alutaceae vel avellaneae, adnatae vel subdecurrentes, latae, confertae vel subdistantes. Stipes cum pileus concolores vel pallidus, glaber. Sporae albae, verruculosae, haud amyloideae, ellipsoideae. Cheilocystidia et pleurocystidia subcylindrica vel subfusiformia, hyalina, laeva. Cutis pileus ex hyphae filamentosae composita, pigmentum incrustata, hyphae ad septae fibulatae. In lichenes vel solum vel muscus. Species typica: *Stachyomphalina striatula* (Kühner) Bigelow

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Figs. 1, 2. *Fayodia alutacea* sp. nov. 1, X3,500. 2, X5,000.

Stachyomphalina striatula (Kühner) Bigelow, comb. nov.Fig.4

Rhodocybe striatula Kühner, Bull. Soc. Linn. Lyon 2: 139. 1928.
Mycena cineraria Smith, North American Species of *Mycena* p. 450. 1947.
Omphalia striatula (Kühner) Kühner & Romagnesi, Fl. Analytique, p. 127. 1953.
Clitocybe striatula (Kühner) Orton, Trans. Brit. Mycol. Soc. 43: 174. 1960.
Fayodia striatula (Kühner) Singer, Beih. Nova Hedwigia 29: 146. 1969.

Pileus 1-3.5(-4) cm broad; pale watery brown or pale dingy yellow brown (smoky brown, pale "buckthorn brown," pale "snuff brown"), hygrophanous and fading to a pale dingy tan or brownish gray or pallid; convex at first with an incurved margin, becoming broadly convex, finally plane with the disc shallowly depressed, sometimes deeply depressed in age; margin long striate when moist, opaque in faded specimens; surface typically glabrous, surface fibrils sometimes becoming diffracted in age and then appearing squamulose; context thin and fragile, pallid. No odor or taste.

Lamellae broadly adnate to short decurrent, moderately broad to broad (up to 4 mm), close or subdistant, white or becoming dingy tan or avellaneous in age.

Stipe 1-3(-6) cm long, apex 1-3 mm thick, equal, surface glabrous, translucent, concolorous with pileus or pallid, solid.

Spores 5.5-7 x 4-4.5 µm (4-spored basidia; up to 11 x 7 µm from 2-spored basidia), ellipsoid, verruculose, deposit white. Basidia 19-27 x 4-8 µm, usually 4-spored but sometimes also 2-spored. Cheilocystidia numerous on some lamellae but rather scattered on others, 33-62(-100) µm long, protruding 15-47 µm beyond hymenium, 5.5-11 µm diam; subcylindric or rather fusoid ventricose, apices obtuse, rounded or subcapitate, smooth, hyaline, walls thin. Pleurocystidia of same type as cheilocystidia but less numerous and very scattered along faces of lamellae. Pileus: cutis brownish in KOH, pigment very finely encrusted on hyphal walls, hyphae cylindric or slightly inflated, 1.5-7 µm diam; context brownish or hyaline in KOH, hyphal walls finely encrusted or more often smooth, hyphae cylindric or inflated, 2.5-20 µm diam. Hymenophoral trama of parallel hyphae, hyaline in KOH, hyphae cylindric or inflated, 6-13(-27) µm diam, walls usually smooth. Clamp connections present.

Gregarious or subcespitose. On or near *Peltigera* and other lichens, in sandy soil or moss. In the open or under spruce. June to October.

Material examined: USA: Alaska: V. Wells and F. Kempton, 20 Sept 1962 (MASS); Miller 7718 (VPI); Colorado: Smith 52049, 52053, 52054, 52055, 52056, 52076, 52107, 52325, 53044 (MICH); Idaho: Smith 68315, 70970, 70972, 71249 (MICH); Michigan: M. Lange 929 (MICH); Smith 6450, 38559, 43619, 75451 (MICH); Oregon: Smith 27595 (MICH); Washington: Smith 17099 (type of *Mycena cineraria* Smith) (MICH);

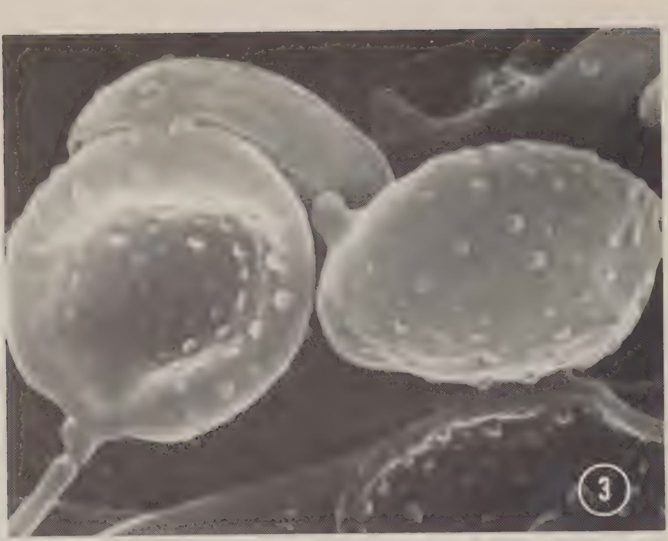
Wyoming: McKnight 10167 (BPI); Smith 34636, 34938, 34941 (MICH). CANADA: Manitoba: DAOM 55724 (DAOM); Northwest Territories, District of Keewatin: DAOM 25872 (DAOM). NORWAY: Horak 76/82 (ZT). SWITZERLAND: Horak 70/578 (ZT). UNITED KINGDOM: Orton 1948, 2549 (E).

The genus *Stachyomphalina* is proposed to accommodate *Rhodocybe striatula* Kühner and any other small species of the Tricholomataceae which have inamyloid verruculose spores. The presence of clamp connections, lamellar cystidia, and encrusted pigments are considered to be of secondary importance.

As illustrated by Figs. 1, 2, and 3, there is a distinct difference between the spore surfaces of *Fayodia* and *Stachyomphalina striatula*. Not only does *S. striatula* lack an ectosporium but the ornamentations are as dissimilar as between a *Russula* and a *Melanoleuca*! There has not been an examination of the wall in section of *S. striatula* as far as I have been able to determine, but under the oil immersion objective the wall below the ornamentation appears thin and without the multiple layers found in *F. gracilipes* by Besson (1969). While it is not difficult to relate *F. gracilipes* and *S. striatula* on most features of the basidiocarp, it seems to me that the different spore morphologies do not support either a direct relationship to one another or a common ancestry.

The spores of *S. striatula* are likewise not like the irregular nodulose spores known for *Mycenella* nor the smooth thick-walled spores of *Myxomphalia*. *Omphaliaster* has nodulose spores with narrow ridges between the protuberances (Bigelow and Rowley, 1968, Fig. 7, as *Clitocybe asterospora*) and *Rhodocybe* has spores which are angular in end view and undulate-pustulate in side view (T. Baroni, personal communication). In *Clitocybe* (*ss. meo*, *Lepista ss. aut auct.*) some species have spores with inamyloid verruculae which are larger, and it would not be difficult to postulate some relationship if only the spores were considered. However, the basidiocarps of Clitocybes which possess ornamented spores are much fleshier in the pilei and stipes than *S. striatula*. There are pigment differences as well, and the type of cystidia found in *S. striatula* is very atypical of Clitocybes.

The ornamentation of *S. striatula* appears to be finely echinulate under the oil immersion objective, but Fig. 3 (Horak 70/578) illustrates that the ornamentation actually consists of verruculae. The spores of several other collections of *S. striatula* and the type of *Mycena cineraria* were studied with the scanning electron microscope and found to be identical to those of the European specimen. Singer (1972) reported that the outer spore layer and ornamentation (as *Fayodia striatula*) were distinctly cyanophilic. This is possible, but I am uncertain of the localization of the stain from tests on the spores of several collections. Unfortunately, the contents of the spores pick up the stain readily and obscure the amount which may be concentrated in the wall. Even in spores which were ruptured or with



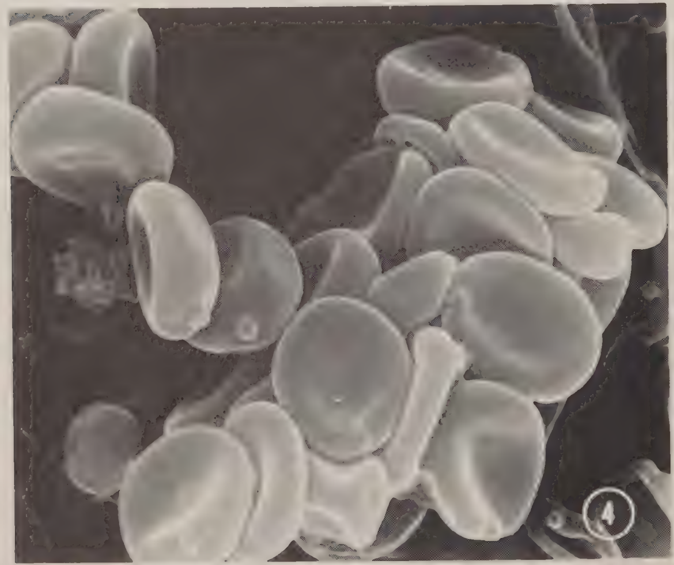


Fig. 3. *Stachyomphalina striatula* (Kühner) Bigelow, X9,000. Fig. 4. *Myxomphalia maura* (Fr.) Hora, X4,000.

plasmolyzed contents, the tests were indecisive due to the thin walls and minute verruculae.

Stachyomphalina striatula is sometimes found under the name *Fayodia leucophylla* (Gillet) M. Lange & Sivertsen. It is debatable if the latter epithet is applicable to the species described here as *S. striatula*. The situation has been discussed by Lange and Sivertsen (1966).

Myxomphalia maura (Fr.) Hora, Trans. Brit. Mycol. Soc. 43: 453. 1960.

This species has been described previously by Smith (1949) and Bigelow (1975). On present records, it is more common in northwestern states than in the northeast. To the collections cited in Bigelow (1975) can be added: Nova Scotia: Harrison 8442 (MICH), and Maine: Litten 844 (MASS). The latter was not typical because of a paler pileus ("greyish yellowish brown" -- ISCC-NBS) and a very weak amyloid reaction to the spores. The other features of this variant were those to be expected for *M. maura*.

In the literature there is disagreement about the spore walls of *M. maura* and this situation provoked a detailed study of the spores of the available North American specimens. Several collections were studied using the scanning electron microscope, and all were rechecked under oil immersion lens. All the spores viewed were smooth as illustrated in Fig. 4. The walls appear thickened under the phase microscope, amyloidity varied in intensity and appeared to be restricted to the outermost portion of the thick wall, and cyanophily was not present in the walls according to several tests. Questions arise -- is more than one species being called "Myxomphalia maura," or is *M. maura* merely variable in some characteristics? The spore surface is reported by Josserand (1937), Horak (1968), and Moser (1978) as being smooth, while Kühner and Romagnesi (1953), Hora (1960), and Pegler and Young (1971) give the spores as smooth or with scattered amyloid verruculae. Singer (1975) has the spores "strongly amyloid, slightly but distinctly heterogeneous, firm and smooth to slightly uneven." Besson (1972, plate 5, fig. 1) has illustrated the spore walls in section under the transmission electron microscope and conical protuberances are evident from the wall. However, she notes that the appearance of ornamentation can differ (1972, p. 23).

Apparently I was mistaken about verruculose spores occurring in North American specimens as well as smooth ones (Bigelow, 1975). Even if ornamentation on a spore collapses after years in the dried state, some remnant should be detectable with the scanning electron microscope.

Other disparities exist in comparing the descriptions of various investigators. Fries (1821) did not record an odor for *Agaricus maurus*, but a farinaceous odor and taste are reported by Moser (1978). On the other hand, Josserand (1937) gives the odor and taste as not farinaceous but clearly fruity (like *Cortinarius paleaceus*), and Kühner (1938) has the odor as slight, "herbacee ou rappelant celle des *Inocybe*, mais jamais farineuse ou rance." None of the North American specimens had an odor; Smith (1949) has noted a farinaceous taste to be present at times. There are also differences to be found in the literature about the length of cystidia, and the substrate of *M. maura*. While it is premature to conclude that modern concepts of *M. maura* actually include more than one species, clearly the collections thought to be *M. maura* need thorough attention.

Acknowledgments

I would like to thank Dr. Robert L. Shaffer, Director, Herbarium, University of Michigan and Dr. Alexander H. Smith, former Director, for the loan of specimens. Dr. Smith also generously contributed field notes and reviewed this manuscript. Others who kindly loaned specimens were: Dr. Egon Horak, Institut für Spezielle Botanik, Zürich, Switzerland; Dr. D. M. Henderson, The Regius Keeper, and Dr. Roy Watling, Royal Botanic Garden, Edinburgh, U.K.; Walter Litten, Ellsworth, Maine.

Grateful appreciation is expressed to Timothy Baroni who provided the critical point drying of the spores of *Fayodia alutacea*. The scanning electron micrographs were made with a JEOL Scanning Microscope Model JSM-35, purchased by National Science Foundation Grant BMS75-02883.

With nostalgia, Dan Stuntz is thanked profusely for his friendship, mycological advice, and gourmet cuisine during the unforgettable years of 1953 and 1954.

Literature Cited

Besson, M. A. 1969. La paroi sporique de *Fayodia bisphaerigera* (Lange) Kühner en microscope électronique et photonique. Compt. Rend. Hebd. Séances Acad. Sci., ser. D: 3167-3169.

__________. 1972. Contribution à la connaisance de l'infrastructure de la paroi sporique des Hyménomycètes. Thèse. L'Universite Claude Bernard de Lyon.

Bigelow, H. E. 1975. Studies in the Tricholomataceae: *Hygrophoropsis, Cantharellula, Myxomphalia, Omphaliaster*. Beih. Nova Hedwigia 51: 61-77.

__________, and J. R. Rowley. 1968. Surface replicas of the spores of fleshy fungi. Mycologia 60: 869-887.

Bresinsky, A., and J. Stangl. 1974. Beitrage zur Revision M. Britzelmayrs "Hymenomyceten aus Südbayern." Z. Pilzk. 40: 69-104.

Fries, E. M. 1821. Systema Mycologicum. I. Lundae.

Hora, F. B. 1960. New check list of British agarics and boleti. Part IV. Validations, new species, and critical notes. Trans. Brit. Mycol. Soc. 43: 440-459.

Horak, E. 1968. Synopsis generum Agaricalium XIII. Beitr. Kryptogamenfl. Schweiz: 9-741.

Josserand, M. 1937. Notes critiques sur quelques champignons de la Région lyonnaise (2^{o} Serie). Bull. Soc. Mycol. France 53: 173-230.

Kühner, R. 1938. Le genre *Mycena*. Encyc. Mycol. 10: 1-710.

__________, and H. Romagnesi. 1953. Flore analytique des champignons supérieurs. Masson et Cie, Paris. 556 p.

Lange, M., and S. Sivertsen. 1966. Some species of *Lyophyllum*, *Rhodocybe*, and *Fayodia* with rough spores. Nomenclature and taxonomic position. Bot. Tidskr. 62: 197-211.

Moser, M. 1978. Die Röhrlinge und Blätterpilze. Kleine Kryptogamenflora IIb/2. Basidiomyceten. 2 Teil. Gustav Fischer, Stuttgart. 532 p.

Pegler, D.N., and T. W. K. Young. 1971. Basidiospore morphology in the Agaricales. Beih. Nova Hedwigia 35: 1-210.

Singer, R. 1972. Cyanophilous spore walls in the Agaricales and agaricoid Basidiomycetes. Mycologia 64: 822-829.

__________. 1975. The Agaricales in modern taxonomy. J. Cramer, Vaduz. 912 p.

Smith, A. H. 1947. North American species of *Mycena*. Univ. Michigan Press, Ann Arbor. 521 p.

__________. 1949. Mushrooms in their natural habitats. Sawyers, Portland. 626 p.

MYCOTAXON

Vol. IX, No. 1, pp. 48-50 June 12, 1979

LIMNOPERDON, A CYPHELLACEOUS FUNGUS WITH GASTEROID BASIDIA?

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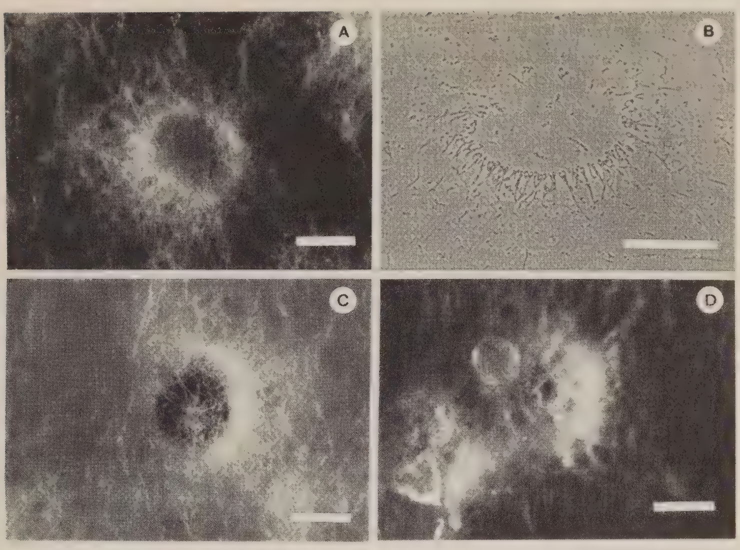
Limnoperdon incarnatum was reported as an unusual uniloculate gasteromycete found floating in dishes containing twigs from a marsh in Washington (Escobar, McCabe and Harpel, 1976). Tubaki (1977) has recovered *L. incarnatum* on wood blocks submerged in brackish waters in Japan. Dr. Tatsuo Yokoyama has kindly provided us with many isolates of *L. incarnatum* that he has repeatedly obtained from rice paddy fields also in Japan. All of these reports agree on the morphology of the fungus and it appears, therefore, that *L. incarnatum* is a well defined and constant organism with at least two widely separated populations.

At the time of our publication of *Limnoperdon* (1976) we were unaware of the sporocarp development of this fungus, but later studies on this subject by the second author revealed some interesting results. McCabe has observed that *Limnoperdon* passes through a cup stage before closing completely. At this cup stage the hymenium is still inmature (Figs. A and B) and spores are only found after the sporocarp is fully closed. But under certain circumstances, which at this time are not fully understood, the sporocarps stop their development at the cup stage and the hymenium continues its normal development resulting in a cupulate sporocarp with an exposed layer of basidia bearing normal and mature spores (Fig. C). The normal fruiting body, in contrast, has a completely enclosed hymenium at maturity (Fig. D).

The abnormal, but fully mature cups, resemble the sporocarps of the cyphellaceous fungi in every respect except for the orthotropic attachment of the spores and the lack of their violent discharge. Oberwinkler (1977a, 1977b) has pointed out that the presence of gasteroid basidia is a common occurrence in many groups of the Hymenomycetes but we are unaware of any cyphellaceous fungus with orthotropically attached basidiospores.



Figures A-D. Limnoperdon incarnatum. A. Early "cup" stage of developing sporocarp. B. Cross section of normal "cup" stage sporocarp. C. Aborted sporocarp bearing mature hymenium. D. Normal mature sporocarp. Bar = 0.25 mm.

The aquatic habitat of Limnoperdon would not be an obstacle to the placement of this fungus on an evolutionary line with the cupulate Basidiomycetes, since these fungi have adapted, at least in the case of Halocyphina (Ginns & Mallock, 1977), to a marine environment. The smooth reddish spores of Limnoperdon, however, do present a problem in connecting this fungus with any known genus of the cyphellaceous Basidiomycetes because there are no known genera in this group of fungi with spores that resemble those of Limnoperdon. One species in the genus Rhodoarrhenia, R. pezizoides (Speg.) Singer, has smooth reddish spores but this fungus has a long stipe and a meruliaceous hymenophore (Singer, 1964).

Just as it is apparent that there are no known genera of cupulate Hymenomycetes that are in a direct evolutionary line with Limnoperdon, it is also true that there are no known Gasteromycetes related to our marsh "puffball". We are of the opinion that a cyphellaceous hymenomycete could have evolved into a uniloculate gasteromycete by the loss of its violent spore discharge as a result of the cupulate sporocarp closing at maturity. This latter characteristic is apparent in several publications on the cupulate Basidiomycetes. After looking at illustrations from Cunningham (1963) and Agerer (1973), we are impressed by the relatively close morphological resemblance of many cyphellaceous fungi to Limnoperdon.

LITERATURE CITED

Agerer, H. 1973. Rectipilus. Eine neue cyphelloider Pilze. Persoonia 7: 389-436.

Cunningham, G.H. 1963. The Thelephoraceae of Australia and New Zealand. New. Zeal. Dept. Sci. & Agr. Res. Bull. #145. 359 pp.

Escobar, G.A., D.E. McCabe & C.W. Harpel. 1976. Limnoperdon, a floating gasteromycete isolated from marshes. Mycologia 68(4): 874-880.

Ginns. J. & D. Malloch. 1977. Halocyphina, a marine basidiomycete (Aphyllophorales). Mycologia 69(1): 53-58.

Oberwinkler, F. 1977a. Das neue System der Basidiomyceten, p. 59-105. in H. Clémençon (ed.). Species Concept in Hymenomycetes. Bibliotheca Mycologica 61. J. Cramer, Vaduz.

Oberwinkler, F. 1977b. The morphology of the basidium and its significance for the phylogeny of the Basidiomycetes. IMC 2 Abstracts: 483.

Singer, R. 1964. New genera of fungi XIII.- Rhodoarrhenia. Sydowia 17: 142-145.

Tubaki, K. 1977. Brackishwater fungi and their relationships to marine fungi. IMC 2 Abstracts: 681.

MYCOTAXON

Vol. IX, No. 1, pp. 51-89 June 12, 1979

THE GENUS PHELLINUS (APHYLLOPHORALES: HYMENOCHAETACEAE) IN WESTERN NORTH AMERICA[1]

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SUMMARY

Twenty-nine species of *Phellinus* are reported to occur in the western United States and Canada. *Phellinus sonorae* is described as a new species causing a root rot of *Dodonaea viscosa* Jacq. in the Sonoran Desert. One new combination, *Phellinus prunicola,* is proposed. Dichotomous and synoptic keys to the species, descriptions, and line drawings of important microscopic structures are provided.

Species of the genus *Phellinus* Quél. are lignicolous Hymenomycetes in the order Aphyllophorales. They have perennial basidiocarps with a hymenophore in the form of united tubes and have brown tissue that gives a darkening or xanthochroic reaction in KOH solution. Hyphae may have simple septa but lack clamp connections. Setae are present in the hymenium of most species and setal hyphae occur in tramal or context tissue of a few. Basidiospores are pigmented or hyaline and negative or dextrinoid in Melzer's reagent. Cultures of many species have been studied and all give a strong positive oxidase reaction on gallic and tannic acid media or with gum guaiac solution. All species of *Phellinus* cause a decay of the white rot type. In major North American taxonomic works these fungi have been placed in the genera *Fomes* (Fr.) Kickx emend. Teix. (Overholts, 1953; Lowe, 1957) and *Poria* (Pers.) S. F. Gray (Lowe, 1966) in the family Polyporaceae. Contemporary workers recognize the genus *Phellinus* in the family Hymenochaetaceae. More information on the historical and taxonomic aspects of this genus may be found in Bondarzew (1953), Domanski et al. (1967), Donk (1960, 1964, 1974), and Jahn (1967).

Many of the western species of *Phellinus* cause decay in living trees and are important factors in the pathology and management of their hosts. Most of the species that decay wood in living trees are confined to the non-living heartwood but a few are actively pathogenic, invading and killing living sapwood. The most important of these pathogens is *Phellinus weirii*, the cause of yellow laminated root rot of Douglas fir. The species included in *Phellinus* in this paper are mostly circumglobal in distribution and generally considered to comprise a natural generic grouping.

Free hand sections were mounted in 4% KOH solution and phloxine and also in Melzer's solution and cotton blue in lactophenol for microscopic studies. Drawings were made with a camera lucida on a Leitz Dialux microscope. Capitalized color names are from Ridgway (1912). Dimensions of microscopic structures are given in µm.

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[1] University of Arizona Agricultural Experiment Station Journal Article No. 2965.

PHELLINUS Quél., Ench. Fung. p. 172. 1886.

Basidiocarps perennial, resupinate, effused-reflexed, or sessile; upper surface glabrous, tomentose or hispid, often blackened and deeply rimose with age; context yellowish brown to reddish brown or purplish brown, spongy to corky or woody, darkening permanently in KOH solution; pore surface yellowish brown to purplish brown, the pores circular to daedaloid; contextual and tramal hyphae thin- to thick-walled, simple-septate or aseptate, clamp connections absent; setal hyphae present or absent; hymenial setae present or absent; basidiospores cylindric to globose, hyaline or pigmented, negative or dextrinoid in Melzer's reagent; lignicolous on living or dead conifers and hardwoods; causing white rots and giving positive oxidase reactions. Type species: *Phellinus torulosus* (Pers.) Bourd. et Galz.

DICHOTOMOUS KEY TO SPECIES OF PHELLINUS IN WESTERN NORTH AMERICA

1. Basidiospores yellowish to dark reddish-brown 2
1. Basidiospores hyaline 6
    2. Setae frequent to abundant 3
    2. Setae absent or extremely rare 4
3. Basidiospores dark reddish-brown; setae up to 25 µm long; on *Quercus* . . . . 5. *P. everhartii*
3. Basidiospores pale yellowish; setae up to 50 µm long; on *Juglans* . . . . 28. *P. weirianus*
    4. Context duplex, with a black layer between spongy upper part and corky lower part . . . . 20. *P. ribis*
    4. Context homogeneous, no black layers present 5
5. Pores 7-8 per mm; on *Robinia* . . . . 21. *P. robineae*
5. Pores 2-5 per mm; on *Prosopis* or *Acacia* . . . . 2. *P. badius*
    6. Basidiospores cylindric to cylindric-ellipsoid 7
    6. Basidiospores ovoid to subglobose 11
7. Setal hyphae abundant in tramal tissue and projecting into tubes . . . . 7. *P. ferrugineofuscus*
7. Setal hyphae lacking or confined to context or marginal tissue 8
    8. Context with one or more thin-layers of black tissue that show as black lines on vertical surfaces; basidiospores attenuated at one end . . . . 13. *P. nigrolimitatus*
    8. Context without black layers; basidiospores cylindrical, straight or curved 9
9. Basidiospores curved, 1.5-2 µm wide . . . . 27. *P. viticola*
9. Basidiospores straight, 2-3.5 µm wide 10
    10. Basidiospores 2-2.5 µm wide; setae up to 30 µm long . . . . 6. *P. ferreus*
    10. Basidiospores 3-3.5 µm wide; setae up to 65 µm long . . . . 8. *P. ferruginosus*
11. Setae projecting 20-50 µm or more 12
11. Setae projecting less than 20 µm or absent 18
    12. Setae projecting 50 µm or more. 13
    12. Setae projecting 20-35 µm 16
13. Setal hyphae abundant in context and tramal tissue and projecting into tubes . . . . 29. *P. weirii*
13. Setal hyphae absent 14
    14. Setae few; on *Crataegus* only . . . . . . 14. *P. occidentalis*
    14. Setae abundant; on conifers. 15

15. Basidiocarps becoming thick; upper surface becoming blackened and deeply rimose . . . . 15. *P. pini*
15. Basidiocarps thin; upper surface remaining hispid or densely hirsute . . . . .3. *P. chrysoloma*
  16. Pore surface dark purplish brown . . . . 9. *P. gilvus*
  16. Pore surface yellowish brown 17
17. Basidiocarps becoming large and thick; at base of living conifers in Arizona . . . . 25. *P. torulosus*
17. Basidiocarps thin; on dead hardwoods . . . . . . .4. *P. conchatus*
  18. Basidiospores subglobose, 6-8.5 µm in diam 19
  18. Basidiospores ovoid, up to 5 µm long 27
19. Basidiospores up to 8.5 µm in diam, dextrinoid in Melzer's reagent; context bright yellowish brown 20
19. Basidiospores up to 6.5 µm in diam, negative in Melzer's reagent; context reddish brown. 24
  20. Basidiocarps sessile, ungulate to applanate, developing on trunks of various desert plants, junipers, or oaks . . 21
  20. Basidiocarps resupinate, or slightly reflexed 22
21. Basidiocarps developing near base of living oaks .22. *P. robustus*
21. Basidiocarps developing near base of numerous desert plants and junipers . . . . 24. *P. texanus*
  22. Basidiocarps bright golden yellow; at base of *Dodonaea* . . . . 23. *P. sonorae*
  22. Basidiocarps colored otherwise; on other substrata 23
23. Basidiocarps developing beneath branch crotches on living conifers . . . . 10. *P. hartigii*
23. Basidiocarps on dead hardwoods and conifers . . .18. *P. punctatus*
  24. Basidiocarps becoming large, up to 20 cm wide 25
  24. Basidiocarps small, up to 5 cm wide 26
25. Pore surface horizontal; basidiocarp ungulate in longitudinal sections; on various hardwoods . . . . . 11. *P. igniarius*
25. Pore surface at about a 45 degree angle; basidiocarps triangular in longitudinal sections; on *Populus* only . . . . 26. *P. tremulae*
  26. On fruit trees . . . . 16. *P. pomaceus*
  26. On *Arctostaphylos* . . . . .1. *P. arctostaphyli*
27. Setae rare; on conifers . . . . .19. *P. repandus*
27. Setae abundant; on hardwoods 28
  28. Pores 6-8 per mm; associated with a uniform white rot of *Prunus* . . . . 17. *P. prunicola*
  28. Pores 8-10 per mm; associated with a white laminated rot, commonly of *Betula* . . . . 12. *P. laevigatus*

SYMBOLS FOR SPECIES IN SYNOPTIC KEY

1. *Phellinus arctostaphyli*; 2. *P. badius*; 3. *P. chrysoloma*; 4. *P. conchatus*; 5. *P. everhartii*; 6. *P. ferreus*; 7. *P. ferrugineofuscus*; 8. *P. ferruginosus*; 9. *P. gilvus*; 10. *P. hartigii*; 11. *P. igniarius*; 12. *P. laevigatus*; 13. *P. nigrolimitatus*; 14. *P. occidentalis*; 15. *P. pini*; 16. *P. pomaceus*; 17. *P. prunicola*; 18. *P. punctatus*; 19. *P. repandus*; 20. *P. ribis*; 21. *P. robineae*; 22. *P. robustus*; 23. *P. sonorae*; 24. *P. texanus*; 25. *P. torulosus*; 26. *P. tremulae*; 27. *P. viticola*; 28. *P. weirianus*; 29. *P. weirii*.

SYNOPTIC KEY TO SPECIES OF PHELLINUS

Habit of basidiocarp
a. resupinate 6, 7, 8, 9, 10, 12, 17, 18, 19, 27, 29
b. sessile 1, 2, 3, 4, 5, 9, 11, 13, 14, 15, 16, 19, 20, 21, 22, 24, 25, 26, 27, 28
c. effused-reflexed 3, 4, 9, 10, 13, 14, 15, 19, 20, 27
Pileus characters
a. applanate 3, 4, 9, 14, 15, 20, 21, 25, 27
b. ungulate 1, 2, 5, 9, 11, 14, 15, 16, 21, 22, 24, 25, 26, 28
c. dimidiate 1, 2, 3, 4, 5, 9, 11, 14, 15, 16, 20, 21, 22, 24, 25, 26, 27, 28
d. elongated 3, 4, 9, 13, 14, 15, 19, 27
Upper surface
a. becoming blackened and rimose 1, 2, 5, 11, 21, 22, 25, 26, 28
b. glabrous or crustlike 1, 4, 11, 16
c. hispid to tomentose 3, 4, 9, 13, 14, 15, 19, 20, 24, 27
d. sulcate 1, 3, 4, 5, 13, 14, 15, 20, 21, 25
Pore surface
a. yellowish brown 2, 3, 4, 5, 6, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 25, 27, 28
b. reddish brown 1, 5, 8, 11, 12, 16, 17, 21
c. purplish brown 7, 9, 26, 29
d. pores 6-10 per mm 4, 6, 7, 8, 9, 12, 13, 16, 17, 18, 20, 21, 22, 23, 25, 26, 28, 29
e. pores 1-6 per mm 1, 2, 3, 5, 8, 11, 14, 15, 19, 24, 27
Context
a. woody 1, 2, 5, 10, 12, 16, 18, 21, 22, 23, 24, 25, 26, 28
b. fibrous 3, 4, 6, 7, 8, 9, 13, 14, 15, 17, 19, 20, 27, 29
c. duplex (with spongy upper layer) 13, 20
d. with thin black layers 13, 19, 25
e. granular core present at base 1, 2, 11, 26
Setae and setal hyphae
a. setae absent 2, 18, 20, 21, 22, 23, 24
b. setae up to 20 µm long 16, 17, 26
c. setae 20-100 µm long 1, 3, 4, 5, 6, 8, 9, 11, 12, 13, 14, 15, 19, 24, 25, 27, 28, 29
d. setal hyphae in context 8
e. setal hyphae in trama and projecting into tubes 7, 29
Basidiospores
a. hyaline 1, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23, 24, 25, 26, 27, 29
b. pigmented 2, 5, 20, 21, 28
c. allantoid 7, 27
d. cylindric to narrowly ellipsoid 6, 8, 13
e. ovoid to globose 1, 2, 3, 4, 5, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29
f. dextrinoid in Melzer's reagent 10, 18, 22, 23, 24
Type of rot
a. white pocket rot 3, 13, 15, 19, 25
b. uniform white rot 1, 2, 4, 5, 6, 8, 9, 10, 11, 12, 14, 16, 17, 18, 20, 21, 22, 23, 24, 26, 27, 28
c. white or yellow laminated rot 7, 12, 29
Substratum
a. heartwood of living trees 1, 2, 3, 5, 9, 10, 11, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25, 26, 28, 29

b. dead trees, stumps, logs, slash 3, 4, 6, 7, 8, 9, 12, 13, 17, 18, 19, 27, 29
c. on conifers 3, 6, 7, 8, 10, 13, 15, 19, 25, 27, 29
d. on hardwoods 1, 2, 4, 5, 6, 8, 9, 11, 12, 14, 16, 17, 18, 20, 21, 22, 23, 24, 26, 27, 28
e. on oaks 5, 9, 22
f. on hawthornes 14
g. on black locust 21
h. on aspen 26
i. on walnut 28
j. on manzanita 1
k. on fruit trees 16
l. on mesquite or acacia 2, 9

Location in living tree

a. trunk rot 1, 2, 3, 5, 10, 11, 14, 15, 16, 21, 24, 28
b. root and butt rot 2, 9, 13, 20, 22, 23, 24, 25, 29

1. *PHELLINUS ARCTOSTAPHYLI* (Long) Niemalä, Ann. Bot. Fenn. 12:120. 1975.

Fomes arctostaphyli Long, N. Mex. Chap. Phi Kappa Phi Papers 1:2. 1917.

Basidiocarps perennial, sessile, applanate to ungulate, dimidiate, 1-9 cm wide and 1-3.5 cm thick; upper surface quickly becoming glabrous and crustose, grayish, sulcate, becoming blackened and rimose with age; margin concolorous to light brown, rounded; pore surface pale grayish brown to dark rusty brown, smooth, the pores circular, 5-6 per mm, dissepiments thick, tomentose, entire; context reddish brown, azonate, fissile, firm, woody, up to 2 cm thick, with a core of tissue near the attachment that has pockets of white mycelium and dark granular masses in a mass of tough, felty mycelium, this core often poorly developed to absent in small specimens; tube layers indistinctly stratified, older layers becoming stuffed with pale mycelium, up to 1 cm thick.

Hyphae of fibrous context parallel, skeletal hyphae thick-walled, aseptate or with occasional simple septa, with rare branching, 2.5-5 diam; core with aggregates of much-branched, interlocked hyphae, some contorted, swollen, often lobed (core setae), thick-walled, dark brown in KOH, up to 10 diam; core also with fibrous tissue made up of interwoven hyaline to golden hyphae, thin- to thick-walled, aseptate, with frequent branching, 1.5-2.5 diam.

Hyphae of trama parallel, skeletal hyphae thick-walled, dark brown in KOH, aseptate, or rarely simple-septate, with rare branching 2.5-5 diam; generative hyphae hyaline to pale yellow, thin-walled, with simple septa and occasional branching, 2-4 diam.

Setae infrequent, subulate, thick-walled, 30-50 x 6-8.5.

Basidia broadly clavate to ellipsoid, 4-sterigmate, 10-12 x 7-8.5.

Basidiospores ovoid, flattened on one side, hyaline, smooth, with slightly thickened walls, negative in Melzer's reagent, cyanophilous, 5-6 x 3.5-4.5.

Type of rot - White rot of heartwood of living manzanita, known on other hosts from a single collection on mountain mahogany in Arizona.

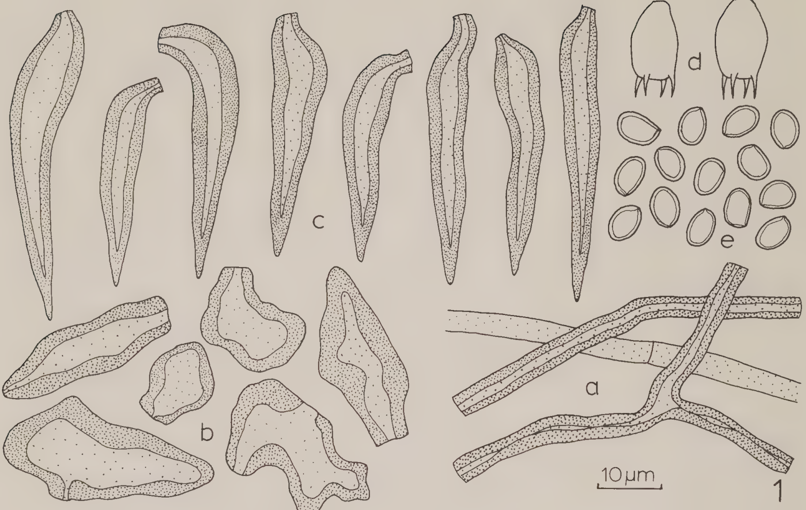
Cultural characteristics - Canfield & Gilbertson (1978).

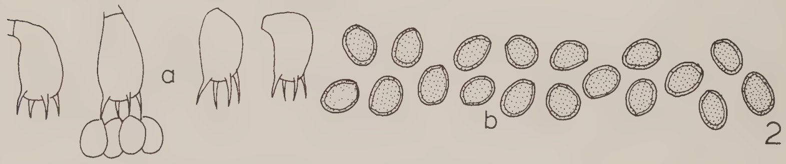
Substrata - *Arctostaphylos* and *Cercocarpus*.

Distribution - AZ, CA, NM, OR.

Voucher specimens - RLG 7846; RLG 7773 (ARIZ).

Remarks - *Phellinus arctostaphyli* was considered a synonym of *P. igniarius* by Overholts (1953) and Lowe (1957). However, it is morphologic-





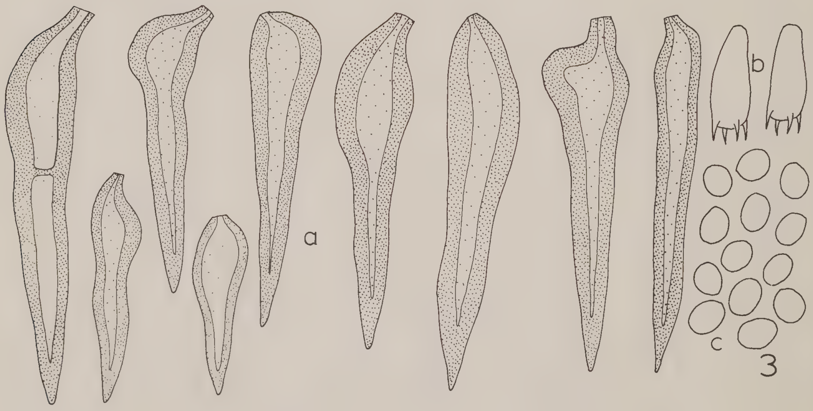


Fig. 1. *Phellinus arctostaphyli* (RLG 7773). a, tramal hyphae; b, core setae; c, setae; d, basidia; e, basidiospores. Fig. 2. *P. badius* (RLG 7737). a, basidia; b, basidiospores. Fig. 3. *P. chrysoloma* (JPL 607). a, setae; b, basidia; c, basidiospores.

ally distinct with longer setae and cyanophilous spores as pointed out by Niemalä (1974).

2. *PHELLINUS BADIUS* (Berk.) G. H. Cunn., N.Z. Dept. Sci. Ind. Res. Bull. 164. p. 233. 1965.
Polyporus badius Berk., Ann. & Mag. Nat. Hist. 7:453. 1841.
Fomes badius (Berk.) Cke., Grevillea 14:18. 1885.
Basidiocarps perennial, sessile, ungulate, up to 16 x 11 x 9 cm; upper surface at first pale brown, tomentose, quickly becoming blackened and rimose; margin yellowish brown, tomentose, up to 1.5 cm wide; pore surface yellowish brown, smooth, glancing, the pores circular to angular, 4-6 per mm, with smooth, entire dissepiments; context bright, lustrous yellowish brown, firm, fissile, faintly zonate, up to 2 cm thick, with a granular core; granular core under 30 X lens consisting of dull yellowish brown, soft, felty mycelium with patches of white mycelium and dark reddish brown, hard, glassy granules scattered throughout; tube layers concolorous, not distinct from context, not distinctly stratified, up to 2 cm thick.
Contextual hyphae of fibrous context compacted in parallel arrangement, simple-septate, thin- to moderately thick-walled, almost hyaline to pale brown in Melzer's reagent, dark brown in KOH, with infrequent branching, 4-6 in diam, some thick-walled, dark brown, 3-9 in diam; tramal hyphae mostly thick-walled, with rare branching, 2-3 diam, rarely septate; hyphae of granular core a mixture of several types; some hyaline to pale yellow, much-branched, thin-to thick-walled, 1-2 diam; dark granules composed of brown swollen hyphal segments aggregated into a sclerotium like mass, shattering into irregular broken fragments under a cover glass.
Setae or other sterile hymenial elements lacking.
Basidia broadly clavate to ellipsoid, 4-sterigmate, 12-14 x 6-7, sterigmata 5-6 long.
Basidiospores ovoid, smooth, dark reddish brown in KOH, negative in Melzer's reagent, thick-walled, 5-7 x 4-6.
Type of rot - White rot of heartwood of living acacia and mesquite in the Sonoran Desert, rarely on other associated hardwoods.
Substrata - *Acacia greggii, Chilopsis linearis, Prosopis juliflora.*
Distribution - AZ, NM, MEXICO.
Voucher specimens - RLG 7834; RLG 7042 (ARIZ).
Remarks - *Phellinus badius* has a circumglobal distribution in the tropics and subtropical regions. It is most similar to *Phellinus robineae* which is found only on *Robinia.*

3. *PHELLINUS CHRYSOLOMA* (Fr.) Donk. Proc. K. Ned. Akad. Wet. (C) 74:39. 1971.
Polyporus chrysoloma Fr., Ofvers. K. Vet. Akad. Forh. 18:30. 1861.
Basidiocarps perennial or sometimes developing for only one season, effused-reflexed to sessile, often resupinate in early stages of development, imbricate in clusters on standing trees and stumps or often in rows on fallen trees, pilei usually thin and applanate, dimidiate to elongated, up to 5 cm wide; upper surface tomentose to hispid, sulcate, zonate, dull reddish brown to bright yellowish brown at the margin; margin usually undulate, slightly lobed, acute, narrowly sterile below; pore surface bright yellowish brown at first, darkening in older specimens, glancing, the pores angular to slightly daedaloid, 1-3 per mm in most specimens but much smaller (4-6 per mm) in others; dissepiments thin, entire to lacerate; context reddish brown, tough-fibrous,

with a thin black layer separating the softer upper tomentum, dense lower layer up to 3 mm thick, upper tomentum up to 1 mm thick; tubes indistinctly stratified, inner surface ochraceous, paler than trama and context, entire tube layer up to 1 cm thick.

Hyphae of fibrous context thin-walled and almost hyaline to thick-walled and bright reddish brown in Melzer's reagent, septate, occasionally to often branched, closely interwoven into a compact tissue, 2-4 diam; hyphae of upper tomentum thin-walled and yellowish to thick-walled and bright reddish brown, septate, with rare branching, 2-5 diam; dark layer between lower context and tomentum composed of dark, closely interwoven hyphae; basidiospores usually abundant on upper surface and in tomentum; tramal hyphae hyaline to yellowish brown thin- to slightly thick-walled, septate, with rare to occasional branching, 2-3 diam.

Setae abundant, subulate, thick-walled, bright reddish brown in KOH, 25-60 x 7-10.

Basidia clavate, 4-sterigmate, 10-12 x 5-6.

Basidiospores ovoid to subglobose, hyaline, becoming pale yellowish brown (particularly those trapped in upper tomentum), smooth, negative in Melzer's reagent, becoming slightly thick-walled, 4-5.5 x 4-5.

Chlamydospores - Scattered in tramal tissue of some specimens; subglobose to ovoid, thick-walled, yellowish brown, 5-5.5 diam.

Type of rot - White pocket rot of living and dead conifers. *Phellinus chrysoloma* also is pathogenic in true firs, killing sapwood, and causing stem cankers in which basidiocarps develop (Owens, 1936).

Cultural characteristics - See Owens, 1936.

Substrata - *Pinus, Pices, Abies, Larix.*

Distribution - Probably present in all western states and provinces.

Voucher specimens - JPL 607; RLG 11508 (ARIZ).

Remarks - This has been considered a variety of *Phellinus pini* but is now recognized as a distinct species by Donk (1974), Ryvarden (1977) and others. The resupinate to effused-reflexed, thin basidiocarps, the upper tomentum separated by a thin dark layer from the lower context, and the narrower, shorter setae are diagnostic characters of *P. chrysoloma.*

4. *PHELLINUS CONCHATUS* (Pers. ex Fr.) Quél.,Ench. Fung. p. 173. 1886.
Polyporus conchatus (Pers. ex Fr.), Syst. Myc. 1:376. 1821.
Fomes conchatus (Pers. ex Fr.) Gill. Champ. France, p. 685. 1878.

Basidiocarps sessile, effused-reflexed, or sometimes resupinate; pilei solitary to imbricate, dimidiate or irregular in shape, up to 11 x 15 x 4 cm; upper surface light brown to black with age, glabrous, incrusted, azonate, sulcate, rough; margin concolorous, rounded to acute; pore surface yellowish brown (Saccardo's Umber), the pores circular, 6-8 per mm with thick, entire dissepiments; context yellowish brown, woody, azonate, with one or more thin black layers, up to 4 mm thick; tube layers concolorous with the context, indistinctly stratified, each layer up to 2 mm thick.

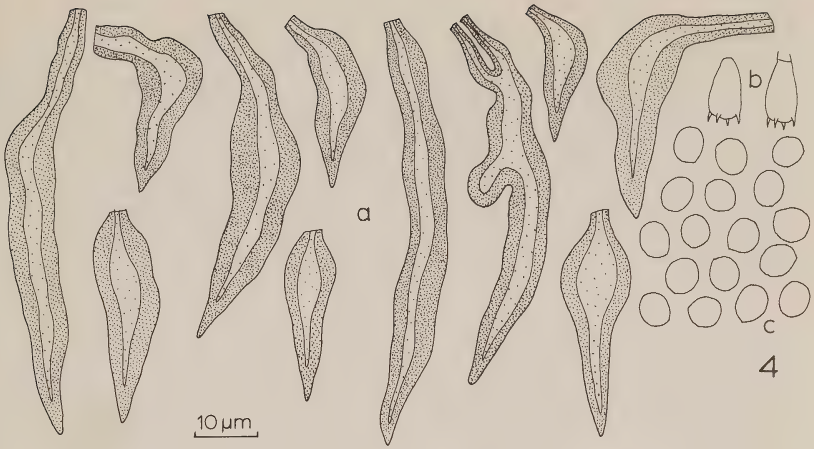
Contextual hyphae brown in KOH, thick-walled, rarely branched, rarely simple-septate, 2.5-4 in diam, also some thin-walled, hyaline, simple-septate, 2-3 in diam; tramal hyphae similar.

Basidia clavate, 4-sterigmate, 10-12 x 6-7.

Setae abundant, ventricose to subulate, thick-walled, 20-50 x 7-9.

Basidiospores ovoid to subglobose, hyaline, smooth, negative in Melzer's reagent, 5-6.5 x 4-4.5.

Type of rot - Uniform white rot of dead wood of several hardwood genera.



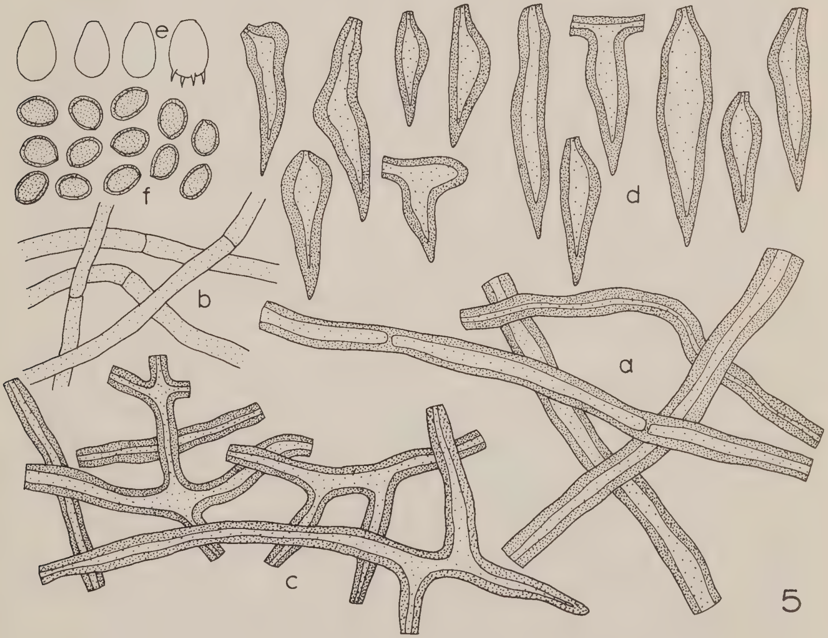
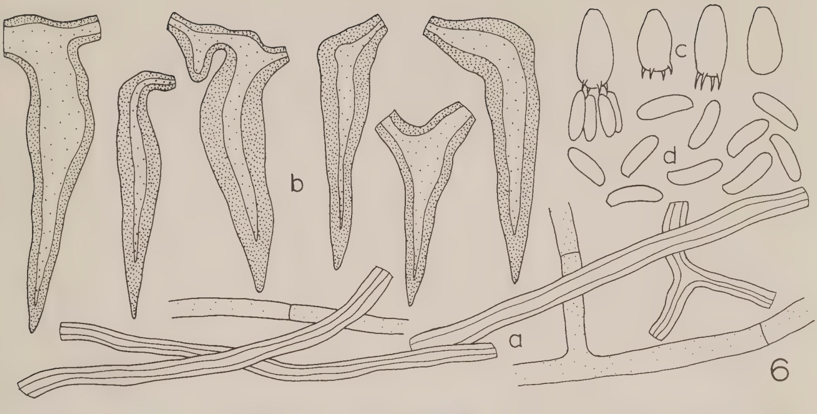


Fig. 4. *Phellinus conchatus* (RLG 9504). a, setae; b, basidia; c, basidiospores. Fig. 5. *P. everhartii* (RLG 7014). a, thick-walled contextual hyphae; b, thin-walled contextual hyphae; c. hyphae from granular context; d, setae; e, basidia; f, basidiospores.

Cultural characteristics - See Campbell (1938), and Nobles (1948, 1958, 1965).
Substrata - *Acer macrophyllum, Alnus incana, Betula papyrifera, Populus trichocarpa, Salix bebbiana,* and *S. lasiandra.*
Distribution - BC, CO, ID, MT, OR, WA, and WY.
Voucher specimens - Weir 18299; Weir 4738 (BPI).
Remarks - *Phellinus conchatus* resembles *P. pini*. The latter species is found on conifers and has pores 2-4 per mm; *P. conchatus* commonly is found on hardwood and has pores 6-8 per mm. Both may have the black layers in the context. Weir confused *P. conchatus* with the fungus later described by Overholts as *P. occidentalis*, and most of his Northwest collections labeled *P. conchatus* are the latter species.

5. *PHELLINUS EVERHARTII* (Ell. et Gall.) Ames, Ann. Myc. 11:246. 1913.
Mucronoporus everhartii Ell. et Gall., Jour. Myc. 5:141. 1889.
Fomes everhartii (Ell. et Gall.) von Schrenk et Spaulding, U.S. Dept. Agr. Pl. Ind. Bul. 149:48. 1909.
Basidiocarps sessile, ungulate, up to 6 x 13 x 8 cm; upper surface yellowish brown to blackish, sometimes very finely tomentose, becoming glabrous and incrusted with age, usually sulcate, rimose; margin concolorous, rounded; pore surface glancing with a golden luster, dark yellowish- to reddish brown (Ochraceous-Tawny, Buckthorn Brown or Cinnamon Brown), the pores circular to angular, 5-6 per mm, with thick, entire dissepiments; context reddish brown, woody, faintly zonate, up to 5 cm thick; tube layers concolorous with the context, rather distinctly stratified, each layer up to 6 mm thick; context with masses of hard granular tissue that appear under 30X lens as dark, solid or resinous areas in a matrix of paler brown interwoven mycelium; hyphae of dark masses agglutinated and hard to separate, tissue breaking out in small chunks.
Contextual hyphae mostly brown in KOH solution, thin- to thick-walled, with rare branching, simple-septate, 3-6.5 in diam, some hyphae hyaline, thin-walled, simple-septate, 2.5-4 in diam; tramal hyphae similar.
Setae frequent to abundant, subulate to ventricose, thick-walled, 16-36 x 5-9.
Basidia ovoid to broadly ellipsoid or subglobose, 4-sterigmate, 8-12 x 5.5-7, simple-septate at the base.
Basidiospores ovoid to subglobose, dark reddish brown, smooth, negative in Melzer's reagent, 4-5 x 3-4.
Type of rot - White rot of heartwood of living oaks.
Cultural characteristics - See Campbell (1938), Davidson et al. (1942), and Nobles (1948, 1958, 1965).
Substrata - *Quercus arizonica, Q. emoryi, Q. gambelii, Q. garryana.*
Distribution - AZ, CA, ID, MT, MEXICO, NM, and OR.
Voucher specimens - RLG 7014 (ARIZ).
Remarks - *Fomes everhartii* is a common species in the oak forests of the southwestern U.S., but is rarely found elsewhere in the West. The dark reddish brown spores, the thin-walled septate hyphae, and thick ungulate fruiting bodies are characteristic features. It is similar to *P. weirianus* but has smaller setae. Furthermore, *P. weirianus* is restricted to walnut.

6. *PHELLINUS FERREUS* (Pers.) Bourd. et Galz., Soc. Mycol. France Bul. 41:247. 1925.
Polyporus ferreus Pers., Myc. Europe 2:89. 1825.



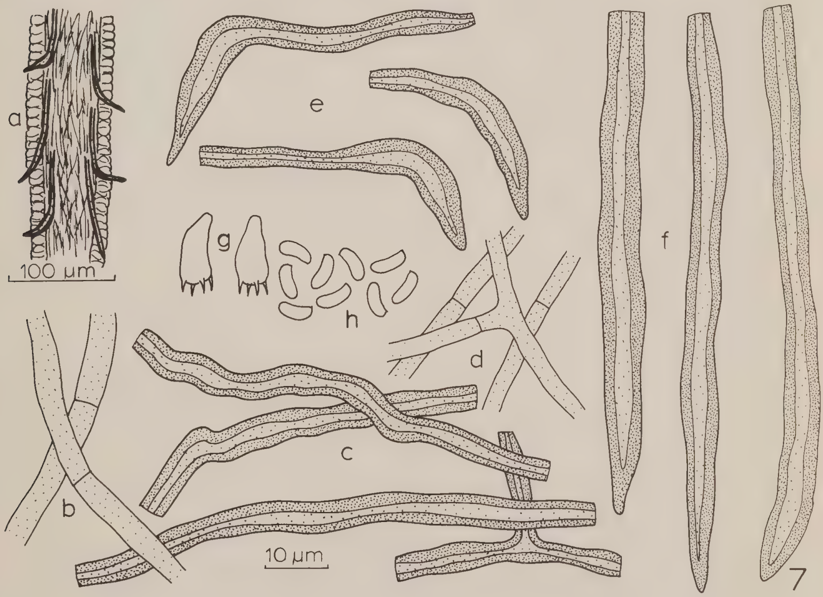


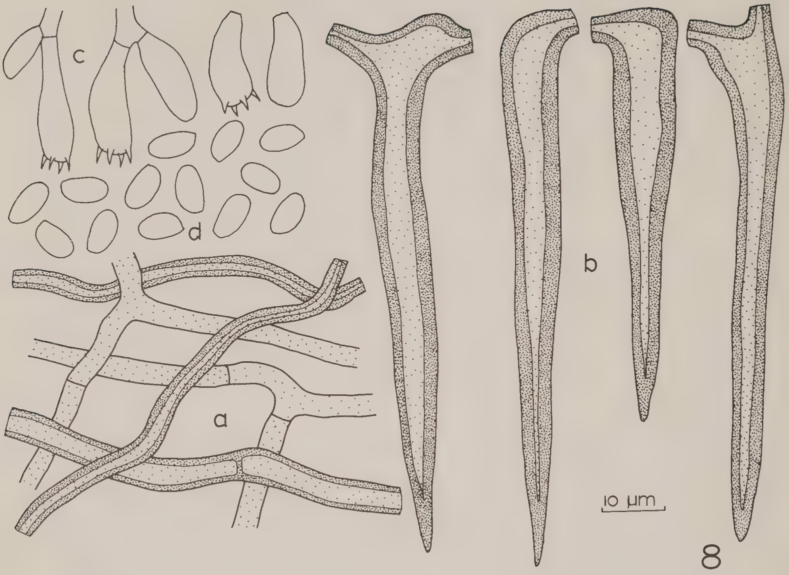
Fig. 6. *Phellinus ferreus* (RLG 3686). a, contextual hyphae; b, setae; c, basidia; d, basidiospores. Fig. 7. *P. ferrugineofuscus* (RLG 6276). a, schematic drawing of hymenial region; b, thin-walled contextual hyphae; c, thick-walled contextual hyphae; d, thin-walled tramal hyphae; e, setae, f, setal hyphae; g, basidia; h, basidiospores.

Poria ferrea (Pers.) Overh. Mycologia 23:117. 1931.
Basidiocarps perennial, resupinate, effused up to 23 cm, woody, not readily separable; margin fertile or narrowly sterile, then yellowish brown, tomentose, up to 2 mm wide; pore surface yellowish brown (Buckthorn Brown or hazel), often cracking extensively, the pores circular, 6-7 per mm, with thick, entire dissepiments; context yellowish brown, corky, azonate, up to 1 mm thick; tube layers indistinctly stratified, concolorous and continuous with the context, each layer up to 1 cm thick.
Contextual hyphae dark brown to almost hyaline in KOH, thick- or thin-walled, with rare branching, rarely simple-septate, 2-4.5 in diam; tramal hyphae similar.
Setae abundant, subulate to slightly ventricose, 22-29 x 6-7.
Basidia clavate, 4-sterigmate, 12-14 x 5-6.
Basidiospores cylindric, hyaline, smooth, negative in Melzer's reagent, 5-7.5 x 2-2.5.
Type of rot - Uniform white rot of dead wood of hardwood and coniferous species.
Cultural characteristics - See Baxter (1934) and Nobles (1948, 1958, 1965).
Substrata - *Abies*, *Acer*, *Alnus*, *Amelanchier*, *Arbutus*, *Arctostaphylos*, *Betula*, *Castanea*, *Castanopsis*, *Cornus*, *Corylus*, *Crataegus*, *Fraxinus*, *Gaultheria*, *Holodiscus*, *Lithocarpus*, *Myrica*, *Physocarpus*, *Picea*, *Populus*, *Prunus*, *Pseudotsuga*, *Quercus*, *Rhus*, *Rubus*, *Salix*, *Thuja*, *Tsuga*, *Umbellularia*, and *Vaccinium*.
Distribution - AK, AT, BC, CA, ID, NWT, MT, OR, and WA.
Voucher specimens - RLG 174 (SY-F); RLG 3394 and 3400 (SY-F).
Remarks - This species is similar to *P. ferruginosus*, another common hardwood-inhabiting fungus. *Phellinus ferruginosus* has shorter spores and usually has setal hyphae in the marginal and context tissue, features which distinguish it from *P. ferreus*.

7. *PHELLINUS FERRUGINEOFUSCUS* (Karst.) Bourd., Soc. Mycol. France Bull. 48:228. 1932.
Poria ferrugineofusca Karst., Soc. Fauna Flora Fenn. Meddel. 14:82. 1887.
Basidiocarps annual or rarely with two layers of tubes, effused up to 20 cm, tough, woody, not easily separable; margin yellowish brown (Sayal Brown) to whitish, soft tomentose, up to 7 mm wide; pore surface purplish brown (Warm Sepia, Natal Brown, or Cinnamon-Brown), the pores circular to angular or sinuous, 7-9 per mm, with thick, entire dissepiments that often split to form sinuous pores; context bright yellowish brown, azonate, tough, fissile, up to 6 mm thick; tube layer purplish brown, tubes lighter within, up to 4 mm thick.
Contextual hyphae of two types, some brownish to hyaline, thin- to thick-walled, simple-septate, with occasional branching, 2.5-5 in diam, others dark brown, thick-walled, rarely branched, rarely septate setal hyphae, 3-3.5 in diam; tramal hyphae similar, the dark, thick-walled setal hyphae projecting into the tubes.
Setae present as ends of setal hyphae, bent abruptly and projecting into the tubes.
Basidia narrowly clavate, 4-sterigmate, 12-14 x 3.5-4.
Basidiospores cylindrical, curved, smooth, hyaline, negative in Melzer's reagent, 4-5.5 x 1-1.5.
Type of rot - White laminated rot of dead wood of conifers. *Phellinus ferrugineofuscus* was reported by Kimmey and Stevenson (1957) as causing

a common heartrot of western red cedar in Alaska. However, the only Alaskan specimen in the National Fungus Collections collected by Kimmey was misidentified and should be referred to *Poria albipellucida* Baxt., a fungus known to cause heartrot in *Thuja plicata*. The wood decayed by *P. ferrugineofuscus* often has small longitudinal pits similar to those seen in wood decayed by *P. weirii*. The wood is also frequently mottled with transversely oriented whitish streaks and may have blackish flecks scattered through it.
Cultural characteristics - See Baxter (1934) and Nobles (1948, 1958, 1965).
Substrata - *Abies*, *Larix*, *Picea*, *Pinus*, *Pseudotsuga*, *Thuja*, and *Tsuga*.
Distribution - AK, AT, AZ, CA, CO, ID, MT, OR, UT, WA, and WY.
Voucher specimens - RLG 8975; RLG 6276 (ARIZ).
Remarks - Other species with hyaline spores and setal hyphae known from this area are *P. weirii* and *P. ferruginosus*. These differ from *P. ferrugineofusca* in the shape of their spores and the consistency and color of their basidiocarps. *Inonotus glomeratus* Peck also has setal hyphae and is frequently resupinate, but is readily identified by its yellowish, ovoid spores.

8. *PHELLINUS FERRUGINOSUS* (Schrad. ex Fr.) Bourd. et Galz., Hym. France. p. 625. 1928.
Polyporus ferruginosus Schrad. ex Fr., Syst. Myc. 1:378. 1821.
Poria ferruginosa (Schrad. ex Fr.) Karst., Rev. Mycol. 3, 9:19. 1881.
Basidiocarps annual, becoming widely effused, tough to soft-spongy, not easily separable; margin tawny, soft-spongy, often appearing setulose under a lens, up to 2 cm wide; pore surface ferrugineous, the pores circular, usually 7-9 per mm, but in some unusual specimens 2-3 per mm, with thick, tomentose dissepiments; context yellowish brown, azonate, soft-fibrous, up to 1.5 mm thick; tube layer slightly darker than the context or concolorous, continuous with the context, up to 2 cm thick.
Contextual hyphae of two types, some light brown in KOH, rather thin-walled, with rare branching, 2-4 in diam, setal hyphae darker reddish brown, very thick-walled, tapering to a setalike point, unbranched, 5-8 in diam; tramal hyphae similar to the thin-walled type.
Setae abundant, mostly subulate, 25-65 x 6-8.
Basidia clavate, 4-sterigmate, 11-14 x 4.5-6.5.
Basidiospores cylindric or short-oblong, hyaline, smooth, negative in Melzer's reagent, 5-7 x 3-3.5.
Type of rot - White laminated rot of dead wood of hardwood and coniferous species.
Cultural characteristics - See Baxter (1934) and Nobles (1948, 1958, 1965).
Substrata - *Abies*, *Acer*, *Alnus*, *Arbutus*, *Betula*, *Corylus*, *Lithocarpus*, *Picea*, *Pinus*, *Populus*, *Prunus*, *Pseudotsuga*, *Quercus*, *Salix*, *Thuja*, *Sequoia*, *Umbellularia*, *Vaccinium*.
Distribution - AK, AT, AZ, BC, CA, CO, ID, MT, NM, NWT, OR, and WA.
Voucher specimens - RLG 3412; RLG 3393 (ARIZ).
Remarks - Considerable variation occurs in basidiocarps of *P. ferruginosus*, especially in pore size. *Phellinus ferreus* is similar but has narrower spores and lacks setal hyphae. Other species of *Phellinus* with setal hyphae are *P. ferrugineofuscus* and *P. weirii*. In those 2 species the setal hyphae occur in the tramal tissue and project into the tubes.



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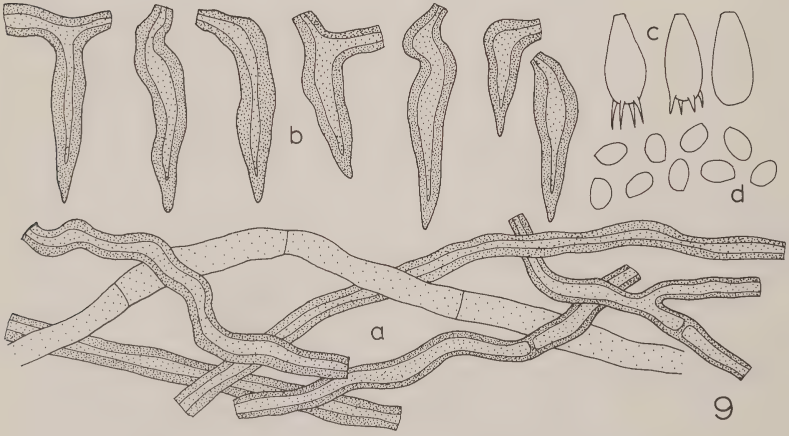

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Fig. 8. *Phellinus ferruginosus* (ERC 71-25). a, contextual hyphae; b, setae; c, basidia; d, basidiospores. Fig. 9. *P. gilvus* (ERC 86). a, contextual hyphae; b, setae; c, basidia; d, basidiospores.

9. *PHELLINUS GILVUS* (Schw.) Pat., Ess. Tax. Hym. p. 97. 1900.
Boletus gilvus Schw., Schr. Nat. Ges. Leipzig 1:96. 1822.
Polyporus gilvus Schw., Schr. Nat. Ges. Leipzig 1:96. 1822.

Basidiocarps perennial or annual, sessile or slightly effused-reflexed; pilei solitary or imbricate, dimidiate, up to 7 x 12 x 3 cm; upper surface dark yellowish brown (Yellow Ocher to Tawny-Olive), tomentose to glabrous, often ruguse, zonate or azonate; margin concolorous; pore surface dark purplish brown (Natal Brown), the pores circular, 6-8 per mm, with thick, entire dissepiments; context bright yellowish brown, zonate, fibrous, up to 2 cm thick; tramal tissue concolorous and continuous with the context, tube layer white-stuffed, up to 1 cm thick.

Contextual hyphae of two types, some dark reddish brown in KOH, thick-walled, rarely branched, simple-septate, 3-7 in diam, others pale yellowish brown, thin-walled, with occasional branching, septate, 3-5 in diam; tramal hyphae similar.

Setae abundant, subulate, sharp, 20-30 x 5-6.

Basidia broadly clavate, 4-sterigmate, 8-11 x 5-7.

Basidiospores ellipsoid to ovoid, hyaline, smooth, negative in Melzer's reagent, 4-5 x 3-3.5.

Type of rot - Uniform white rot of dead wood of hardwoods and a heart rot of living trees.

Cultural characteristics - See Davidson et al. (1942), Nobles (1948, 1958, 1965), and Gilbertson and Burdsall (1972).

Substrata - *Alnus, Betula, Fraxinus, Juglans, Phoenix, Platanus, Populus, Prosopis, Prunus, Quercus, and Salix.*

Distribution - AZ, CA, ID, MT, NM, OR, and WA.

Voucher specimens - RLG 7736; RLG 7180 (ARIZ).

Remarks - *Phellinus gilvus* is a common fungus on hardwoods along streams at lower elevations in the Southwest. The purplish color of the pore surface is very characteristic. It is most similar morphologically to *P. torulosus* which occurs at higher elevations on conifers and has larger spores. The two also differ greatly in culture.

10. *PHELLINUS HARTIGII* (Allesch. et Schnabl.) Bond., Polyp. Eur. USSR and Caucasia. p. 365. 1953.
Polyporus hartigii Allesch. et Schnabl., Fungi Bavar. exs. No. 48. 1890.

Basidiocarps perennial, resupinate to effused-reflexed; when reflexed more or less triangular in longitudinal sections with upper and lower surfaces at angles of 45° or greater; upper surface pale yellowish brown, tomentose near the margin, becoming glabrous and rimose, grayish brown to purplish brown, the pores circular, 5-7 per mm, with thick, entire dissepiments; context woody, yellowish brown to reddish brown, with darker zones, up to 2 cm thick; tube layers distinctly stratified, often with sterile tissue between the layers, tubes white within, layers up to 5 mm thick.

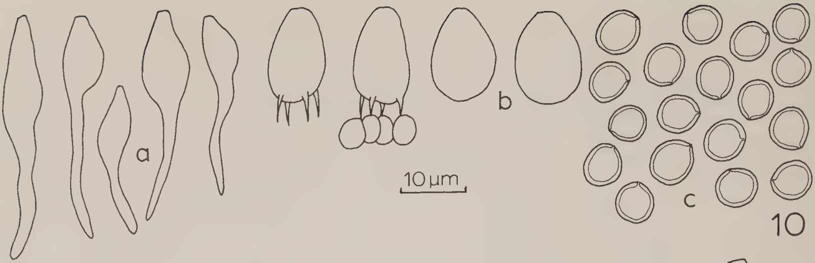
Contextual hyphae pale yellowish brown in Melzer's reagent, thick-walled, aseptate or with rare septa, 2-5 diam, with rare branching; some almost hyaline, slender, aseptate, thick-walled, much-branched hyphae also present, these 1-1.5 diam; tramal hyphae similar.

Setae lacking; ventricose, thin-walled cystidioid elements present.

Basidia broadly ellipsoid, 4-sterigmate, 12-14 x 8-9.

Basidiospores subglobose, hyaline, smooth, slightly thick-walled, strongly dextrinoid in Melzer's reagent, 5-6.5 x 6-7.5.

Type of rot - Uniform white rot of heartwood of living conifers, continuing in dead trees and logs.



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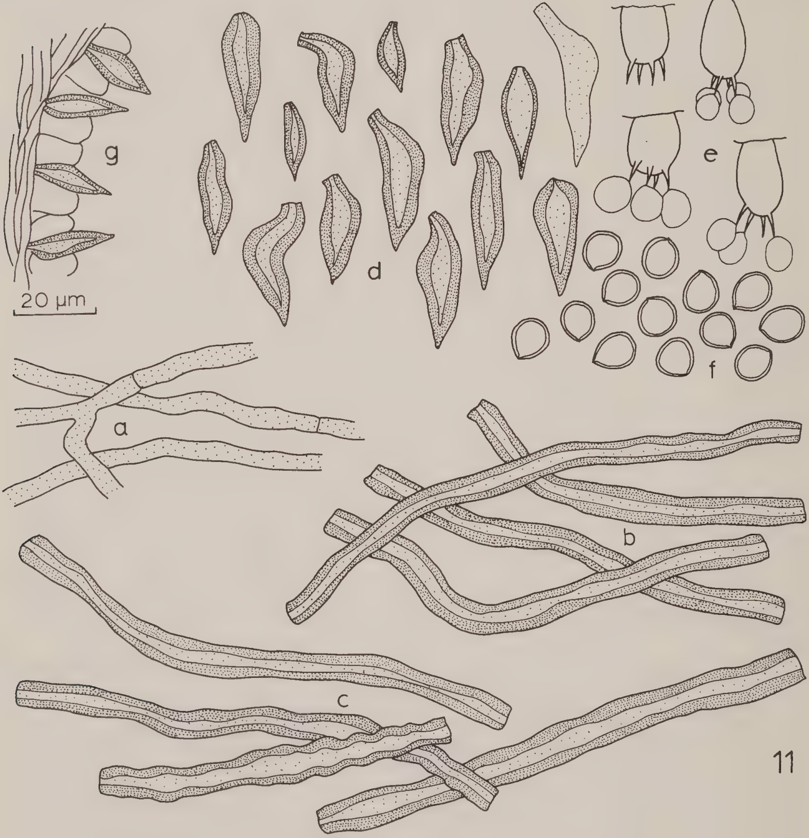

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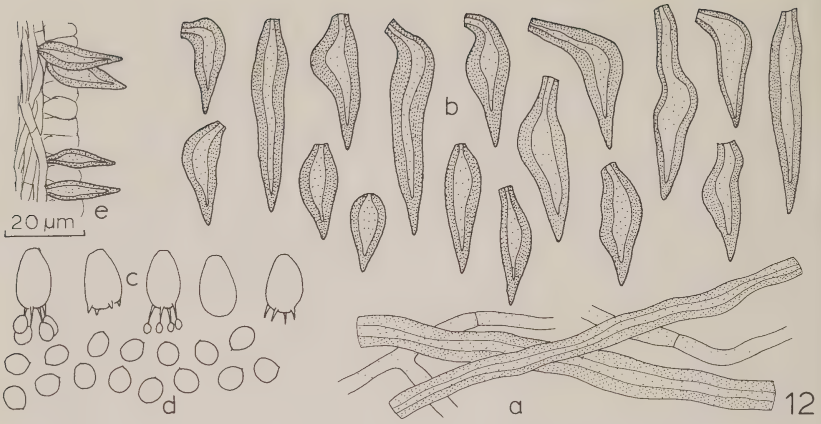
Fig. 10. *Phellinus hartigii* (FP 10557). a, thin-walled cystidioid elements from hymenium; b, basidia; c, basidiospores. Fig. 11. *P. igniarius* (RLG 8575). a, thin-walled tramal hyphae; b, thick-walled tramal hyphae; c, thick-walled contextual hyphae, d, setae; e, badisia; f, basidiospores; g, schematic drawing of hymenium.

Cultural characteristics - See Baxter (1934, 1945, as *Poria tsugina*; 1952, as *Fomes robustus tsugina*); Campbell (1938, as *Fomes robustus* var. *tsugina*); and Nobles (1948, 1958, 1965, as *Poria tsugina*).
Substrata - *Abies, Pseudotsuga, Tsuga.*
Distribution - AK, AZ, BC, CA, CO, ID, NM, WA.
Voucher specimens - FP 6034; FP89887 (CFMR).
Remarks - The *Phellinus robustus* complex is probably the most difficult taxonomic problem in the genus. Speciation in this complex has resulted from adaptation to different substrata and vastly different environmental factors. Morphological differences, both macroscopic and microscopic, have also evolved. *Phellinus hartigii* is recognized essentially on the basis of characters detailed by Lohwag (1937), Jahn (1976), and Domanski et al. (1967).

11. *PHELLINUS IGNIARIUS* (L. ex Fr.) Quél., Ench. Fung. p. 172. 1886.
Polyporus igniarius L. ex Fr., Syst. Myc. 1:375. 1821.
Fomes igniarius (L. ex Fr.) Kickx, Fl. Crypt. Flandres 2:237. 1867.
Basidiocarps perennial, sessile or rarely effused-reflexed, ungulate or sometimes applanate, up to 11 x 20 x 8 cm; upper surface gray or blackish, glabrous, sulcate, becoming deeply rimose, incrusted; margin concolorous and glabrous or yellowish brown, (Saccardo's Umber or Snuff Brown); pore surface pale cinnamon brown to dark purplish brown, the pores circular, 5-6 per mm, with thick, entire dissepiments; context dark reddish brown, zonate, woody, up to 2 cm thick; core absent or present next to substratum, with white tissue intermixed; tube layers concolorous with context, the tubes white-stuffed, in indistinct layers, each up to 4 mm thick.
Contextual hyphae of two types, some brown in KOH, thick-walled, distinct, with rare branching, aseptate, 2-5 in diam, some hyaline, thin-walled with occasional simple septa, very indistinct; tramal hyphae similar, 2-3 in diam.
Setae ventricose to subulate, abundant to rare, 14-17 x 4-6; core setae present in some specimens, irregularly lobed and branched; thick-walled, up to 15 in diam.
Basidia broadly clavate, 4-sterigmate, 9-10 x 6-7.
Basidiospores broadly ovoid to subglobose, hyaline, smooth, thick-walled, negative in Melzer's reagent, acyanophilous, 5-6.5 x 4.5-6.
Type of rot - Uniform white rot of the heartwood of living hardwoods.
Cultural characteristics - See Campbell (1938), Niemalä (1977), Nobles (1948, 1958, 1965), and Verral (1937).
Substrata - *Acer, Alnus, Arbutus, Betula, Castanopsis, Cornus, Malus, Prunus, Pyrus, Quercus, Rhamnus, Salix, Sambucus.*
Distribution - AK, AT, BC, CA, CO, ID, MT, OR, UT, WA, and WY.
Voucher specimens - RLG 8575; RLG 5844 (ARIZ).
Remarks - The *Phellinus igniarius* complex has been another difficult taxonomic problem. *Phellinus arctostaphyli* is segregated on the basis of characters detailed under that species. *Phellinus tremulae* occurs only on aspen and is morphologically distinct on the basis of basidiocarp macro- and micromorphology as well as cultural characters. *Phellinus pomaceus* is most similar and is characterized mainly by small basidiocarps on *Prunus*. Niemalä (1972, 1974, 1975, 1977) should be consulted for a detailed discussion of the *P. igniarius* complex.

12. *PHELLINUS LAEVIGATUS* (Fr.) Bourd. et Galz., Hym. France p. 264. 1928.
Polyporus laevigatus Fr., Hym, Eur. p. 571. 1874.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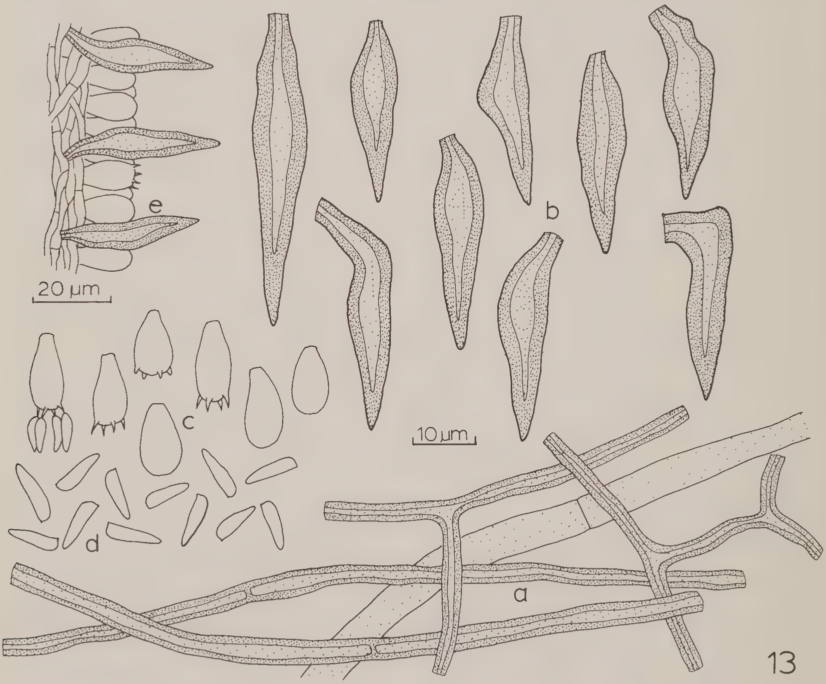
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Fig. 12. *Phellinus laevigatus* IRLG 179). a, contextual hyphae; b, setae; c, basidia; d, basidiospores; e, schematic drawing of hymenium. Fig. 13. *P. nigrolimitatus* (RLG 5861). a, contextual hyphae; b, setae; c, basidia; d, basidiospores; e, schematic drawing of hymenium.

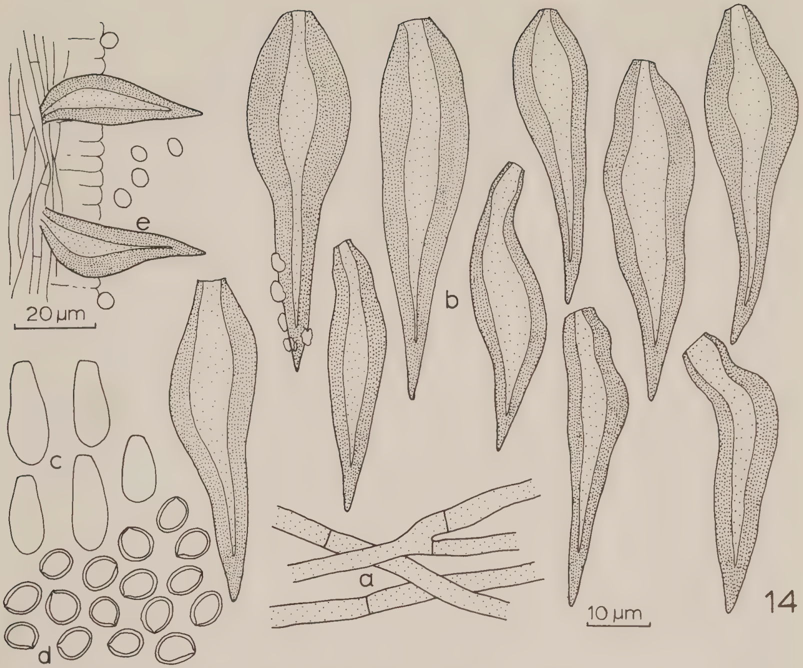
Basidiocarps perennial, resupinate, becoming widely effused, woody, adnate; pore surface dull reddish brown (Prout's Brown to Warm Sepia) often becoming deeply cracked into angular blocks with age or drying, the pores circular, 8-10 per mm, with thick, entire dissepiments; margin yellowish-brown (Ochraceous-Tawny), tomentose, up to 2 mm wide; context yellowish brown, azonate, up to 2 mm thick; tube layers indistinctly stratified, paler than context, each layer up to 1 mm thick.
Contextual hyphae of two types, some dark brown in KOH, thick-walled, rarely branched, aseptate, 2.5-5 in diam; others pale yellowish to hyaline in KOH, thin-walled, simple-septate, with frequent branching, 2-3.5 in diam; tramal hyphae similar, with parallel arrangement.
Setae abundant, subulate to ventricose, thick-walled, 17-30 x 6-9.
Basidia subglobose to pyriform, 2-4 sterigmate, 7-11 x 4-5.
Basidiospores ovoid, hyaline to pale golden yellow in older specimens, smooth, negative in Melzer's reagent, 3-4 x 2.5-3.
Type of rot - White laminated rot of dead hardwoods, especially birch. The wood in advanced stages of decay separates readily along the annual rings.
Cultural characteristics - See Campbell (1938), Baxter (1952), Nobles (1958, 1965), and Niemalä (1972).
Substrata - Alnus, Betula, and Populus.
Distribution - BC, ID, MT, OR, WA.
Voucher specimens - RLG 179; RLG 341 (ARIZ).
Remarks - Phellinus laevigatus has been considered a resupinate state of *P. igniarius* by Overholts (1953) and Lowe (1958, 1966). However it is morphologically distinct by its smaller spores and also causes a different type of rot. Niemalä (1972) has also pointed out that the arrangement of the tramal hyphae is different in the two species, being parallel in *P. laevigatus* and interwoven in *P. igniarius*.

13. *PHELLINUS NIGROLIMITATUS* (Rom.) Bourd. et Galz., Hym. France p. 622. 1928.
Polyporus nigrolimitatus Rom., Arkiv f. Bot. 11, 3:18. 1912.
Fomes nigrolimitatus (Rom.) Egeland, Mag. f. Naturvidenskaberne (Nyt.) 52:135. 1914.
Fomes putearius Weir, J. Agric. Res. 2:165. 1914.
Basidiocarps effused-reflexed or resupinate; pilei usually irregular in shape, more or less elongated and shelflike, up to 5 x 10 x 4 cm; upper surface blackish brown to yellowish or reddish brown, finely tomentose to glabrous, very irregular, often soft and spongy; margin concolorous or sometimes lighter (Snuff Brown to Buckthorn Brown), up to 3 mm wide; pore surface Cinnamon, smooth, the pores circular to angular, sometimes daedaloi in part, 5-7 per mm, with thick, entire dissepiments; context dark yellowish brown, with one or more thin black layers that appear as black lines in longitudinal sections, often zonate, corky to soft-fibrous, up to 1 cm thick; tube layers indistinct, lighter brown than context, each layer up to 2 mm thick.
Contextual hyphae brown to pale yellow or almost hyaline in KOH, thick- or thin-walled, with frequent branching, simple-septate, 2.5-6 in diam; black layers about 20-80 thick, composed of very closely interwoven and agglutinated hyphae; tramal hyphae similar to those of lower context.
Setae abundant, straight, subulate to ventricose, 25-37 x 6.5-8.5.
Basidia broadly clavate, 4-sterigmate, 10-12 x 5-6.5.
Basidiospores cylindric, straight, tapering at the apex, hyaline, smooth, negative in Melzer's reagent, 7-10 x 2-2.5.

Type of rot - White pocket rot of conifer logs and also a root and butt rot of living trees. The rot is distinctive because of the large size of the pockets, which are up to 2.5 cm long. The wood between the pockets is firm.
Cultural characteristics - See Nobles, 1948, 1958, 1965; Baxter, 1945.
Voucher specimens - RLG 8271; RLG 11511 (ARIZ).
Remarks - In North America this species is known only from the West, where it is common in many areas, especially at higher elevations in the spruce-fir zone. When entirely resupinate, the basidiocarps are easily mistaken for those of other species of *Phellinus,* particularly those of softer consistency, such as *P. weirii* and *P. ferrugineofusca.* The black layers in the context and the distinctive carrot-shaped spores are features which facilitate identification of resupinate specimens.

14. *PHELLINUS OCCIDENTALIS* (Overh.) Gilbn. in Lombard, et al., Mycopath. et Mycol. Appl. 46:352. 1972.
Fomes occidentalis Overh. in Lombard et al., ibid.
(*Fomes occidentalis* Overh., Mycologia 33:101. 1941. Not validly published - no Latin diagnosis)
Basidiocarps perennial, effused-reflexed or sessile, sometimes resupinate at first; pilei dimidiate or laterally fused and elongate, up to 2 x 6 x 4 cm; upper surface blackish to grayish, faintly sulcate and zonate, incrusted, glabrous; margin light yellowish brown (Warm Buff or Cinnamon-Buff), faintly tomentose, up to 1 mm wide, rounded; pore surface light brown (Snuff Brown or Dresden Brown), the pores angular to circular, 2-4 per mm, with thick, entire dissepiments; context light reddish brown, azonate, corky, up to 2 mm thick; the upper incrusted layer blackish; tube layers concolorous and continuous with context, up to 1.5 cm thick, the tubes lighter within.
Contextual hyphae of two types, some dark brown in KOH, thin- to thick-walled, rarely simple-septate, with rare branching, 2-5 in diam, others hyaline or pale yellowish, thin-walled, simple-septate, with frequent branching, 2-3 in diam; tramal hyphae similar.
Setae scattered, thick-walled, ventricose, 40-50 x 8-14.
Basidia clavate, 4-sterigmate, 11-16 x 5-5.5.
Basidiospores ovoid to subglobose, hyaline, in old specimens distinctly brown, smooth, negative in Melzer's reagent, 5-6 x 4-5.
Type of rot - Uniform white rot of heartwood of living hawthorne (Lombard et al. 1972).
Cultural characteristics - See Lombard, et al. (1972).
Substrata - *Crataegus columbiana, C. douglasii, C. piperi.*
Distribution - ID, MT, OR, UT, WA.
Voucher specimens - RLG 2060; RLG 4674 (ARIZ).
Remarks - *P. occidentalis* is quite similar to *P. chrysoloma* and *P. pini.* Its restriction to hawthorn and the uniform white rot are diagnostic.

15. *PHELLINUS PINI* (Thore. ex Fr.) Pilát, Atl. Champ. Eur. III (1). p. 517. 1942.
Fomes pini (Thore. ex Fr.) Karst., Bidr. Finl. Nat. O. Folk. 37:79. 1882.
Boletus pini Thore, Chloris Dept. Landes, p. 487. 1803.
Daedalea pini Brot. ex Fr., Syst. Myc. 1:336. 1821.
Trametes pini Thore ex Fr., Epicr. Syst. Myc., p. 489. 1836-1838.
Cryptoderma yamanoi Imazeki, Forsch. auf. dem. Geb. Pflanzenkrank (Japan) 4:176. 1951.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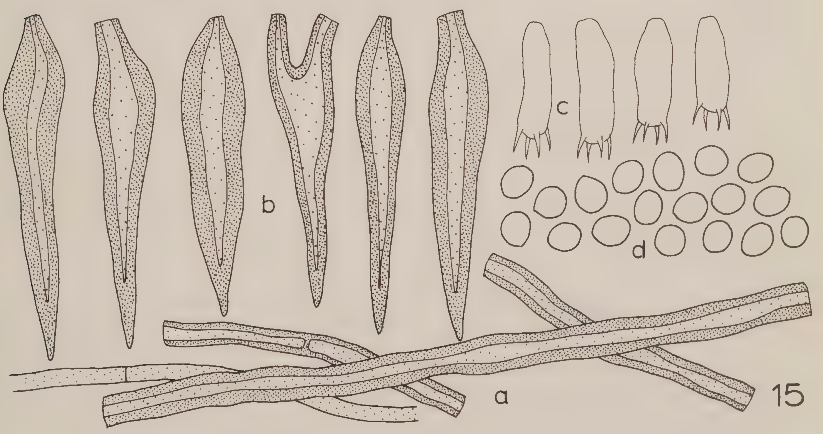


Fig. 14. *Phellinus occidentalis* (RLG 4674). a, thin-walled tramal hyphae; b, setae; c, basidia; d, basidiospores; e, schematic drawing of hymenium. Fig. 15. *P. pini* (RLG 9407). a, tramal hyphae; b, setae; c, basidia; d, basidiospores.

Basidiocarps sessile, effused-reflexed, or sometimes entirely resupinate; pilei solitary or imbricate, ungulate to applanate, up to 9 x 13 x 8 cm; upper surface light reddish-brown to blackish, hirsute toward the margin, becoming glabrous and incrusted with age, zonate and sulcate; margin reddish-brown and hirsute, or sometimes yellowish-brown (Antimony Yellow) and tomentose, rounded; pore surface yellowish-brown (Tawny-Olive to Yellow Ocher), the pores circular to angular or daedaloid, 2-3 per mm, with thick, entire dissepiments; context reddish-brown or yellowish-brown, lustrous on cut surface, corky, usually with one or more thin black layers, in younger specimens often appearing duplex because of the hirsute upper layer, up to 3 cm thick; tramal tissue continuous and concolorous with context, tubes light colored within, indistinctly stratified, each layer up to 6 mm thick.
Contextual hyphae rarely branched, simple-septate, of two types, some brown in KOH, thick- or thin-walled, 3.5-7.5 in diam., others hyaline, thin-walled, 2-3 in diam; tramal hyphae similar.
Setae abundant, subulate to ventricose, 40-50 x 10-14.
Basidia broadly clavate, 4-sterigmate, 12-14 x 5-6.
Basidiospores ovoid, hyaline, smooth, negative in Melzer's reagent, 4.5-7 x 3.5-5.
Type of rot - White pocket rot of the heartwood of living conifers.
Cultural characteristics - See Campbell (1938), Fritz (1923), Davidson et al. (1938), Nobles (1948, 1958, 1965), and Owens (1936).
Substrata - *Abies, Chamaecyparis, Larix, Libocedrus, Picea, Pinus, Pseudotsuga, Taxus, Thuja,* and *Tsuga.*
Distribution - AK, AT, AZ, BC, CA, CO, ID, MT, NM, OR, SASK., WA, WY, and UT.
Voucher specimens - RLG 9407; RLG 6630 (ARIZ).
Remarks - *P. chrysoloma* is closely related and has been referred to as *Fomes pini* var. *abietinus* (Karst.) Overh. *P. occidentalis* is similar and can be distinquished by its host, *Crataegus*, and the associated uniform white rot. Boyce and Wagg (1955) have reported the pathogenic relationship of *P. pini* in stands of Douglas fir and a cyclic pattern of decay over a 450 year rotation.

16. *PHELLINUS POMACEUS* (Pers. ex S. F. Gray) Maire, Fungi Catal. I. p. 37. 1932.
Boletus pomaceus Pers. ex S. F. Gray, Nat. Arr. Brit. Plants 1:642. 1821.
Fomes pomaceus (Pers. ex S. F. Gray) Lloyd, Mycol. Writings C. G. Lloyd 2:8. 1908.
Basidiocarps perennial, sessile or effused-reflexed; pilei ungulate, solitary or imbricate, up to 5 x 5 x 6 cm; upper surface at first light grayish-brown, smooth, lightly tomentose, becoming blackened, rimose and glabrous; margin light brown, rounded; pore surface dark yellowish- to reddish-brown, the pores circular, 7-9 per mm, with thick, entire dissepiments; context yellowish-brown to reddish-brown, shining, zonate, woody, up to 1 cm thick; tube layers concolorous, distinctly stratified, tubes dull, becoming whitish within.
Contextual hyphae mostly brownish in KOH, thick-walled, with rare to frequent branching, simple-septate, 2.5-5.5 in diam, some hyaline, thin-walled, simple-septate, 2-3 in diam; tramal hyphae usually similar, some thin-walled, pale brownish to hyaline.
Setae rare, subulate to ventricose, 14-17 x 4.5-7.
Basidia broadly clavate, 4-sterigmate, 9-10 x 5.5-6.
Basidiospores ovoid to broadly ellipsoid, hyaline, smooth, negative in Melzer's reagent, 4-5 x 3-4.5.

Type of rot - Uniform white rot of the heartwood of living fruit trees.
Cultural characteristics - See Campbell (1938), Nobles, (1948, 1958, 1965 as *Fomes fulvus*); and Niemalä (1977).
Substrata - *Prunus*.
Distribution - CO, ID, MT, NM, OR, WA, and WY.
Voucher specimens - WGS 07711; JFB 1001 (ARIZ).
Remarks - Niemalä (1977) has pointed out that the arrangement of skeletal hyphae in the trama of *P. pomaceus* is intermediate between parallel and interwoven and refers to this as subparallel. Similar species in the *Phellinus igniarius* complex are *P. igniarius*, which has interwoven tramal skeletals, and *P. laevigatus*, which has parallel tramal skeletals. Basidiospores on North American specimens are smaller than those on European specimens as stated by Niemalä (1977).

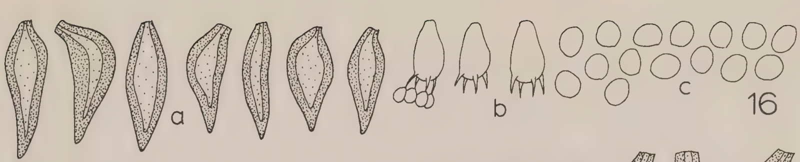
17. *PHELLINUS PRUNICOLA* (Murr.) Gilbn., comb. nov. (basionym - *Fomitoporia prunicola* Murr., North Amer. Flora 9:9. 1907.)
Poria prunicola (Murr.) Sacc. & Trott., Syll. Fung. 21:331. 1912.
Basidiocarps perennial, resupinate, woody, effused up to 22 cm, not readily separable; margin at first light yellowish brown, becoming blackened, glabrous and rimose with age; pore surface reddish brown (Snuff Brown to Saccardo's Umber), the pores circular, 6-8 per mm, with thick, entire dissepiments; context reddish brown, woody, azonate, up to 1 mm thick; the tube layers indistinctly stratified, becoming whitish within, each layer up to 2.5 mm thick.
Contextual hyphae mostly dark reddish-brown in KOH, thick- to thin-walled, with rare branching, aseptate, 2.5-4 in diam, some pale brownish to hyaline, thin-walled with frequent branching, simple-septate, 2-3 in diam; tramal hyphae similar, arrangement of skeletals semiparallel.
Setae abundant, mostly ventricose, 15-18 x 5-6.5.
Basidia clavate, 4-sterigmate, 11-12 x 5-6.
Basidiospores ovoid to subglobose, hyaline, smooth, negative in Melzer's reagent, 3.5-5 x 2.5-3.5.
Type of rot - Uniform white rot of dead wood of *Prunus*.
Cultural characteristics - See Baxter, 1934.
Distribution - MT.
Voucher specimen - RLG 653 (ARIZ).
Remarks - *P. laevigatus* is very similar but has slightly smaller spores and pores. Baxter (1934) believes the two are distinct in culture. Resupinate specimens of *P. robustus* differ in their larger, dextrinoid spores and lack of setae. *Phellinus igniarius* has considerably larger spores.

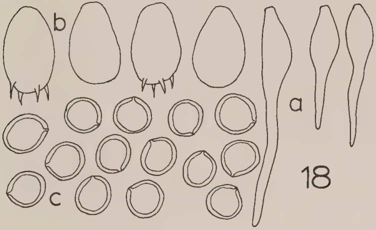
18. *PHELLINUS PUNCTATUS* (Fr.) Pilát, Atl. Champ. Europe 3:530. 1942.
Poria punctata (Fr.) Karst. Bidr. Finl. Natur. O. Folk. 37:83. 1882.
Polyporus punctatus Fr., Hymen. Eur. p. 572. 1874.
Basidiocarps perennial, resupinate, becoming widely effused, woody, not readily separable; margin at first yellowish brown, tomentose, up to 2 cm thick, receding, becoming black and rimose in older specimens; pore surface yellowish- to grayish brown, dull, smooth, the pores circular, 6-8 per mm, the dissepiments thick, entire, minutely tomentose;
Contextual hyphae dark brown in KOH, thin- to thick-walled, rarely branched, occasionally septate, 2.5-5 in diam, some almost hyaline, thinner walled; tramal hyphae similar.
Setae lacking; thin-walled, ventricose cystidioid elements present.
Basidia broadly clavate, 4-sterigmate, 11-12.5 x 7-8.5.

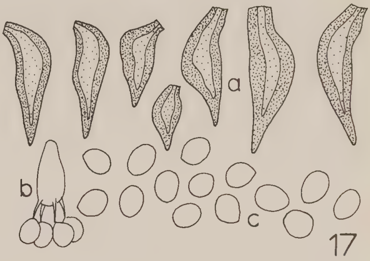
Basidiospores broadly ovoid to subglobose, hyaline, smooth, strongly dextrinoid in Melzer's reagent, 6.5-8.5 x 5.5-7.
Type of rot - Uniform white rot of dead wood of hardwoods and conifers.
Cultural characteristics - See Nobles (1948, 1958, 1965).
Substrata - *Abies, Alnus, Betula, Picea, Pseudotsuga, Salix, Tsuga.*
Distribution - AK, AT, BC, CA, CO, ID, OR.
Voucher Specimens - RLG 6677; RLG 6713 (ARIZ).
Remarks - Specimens on conifer substrata have been referred to *Poria tsugina* (Murr.) Sacc. et Trott. *Phellinus hartigii* is closely related and is differentiated by reflexed basidiocarps on living conifers.

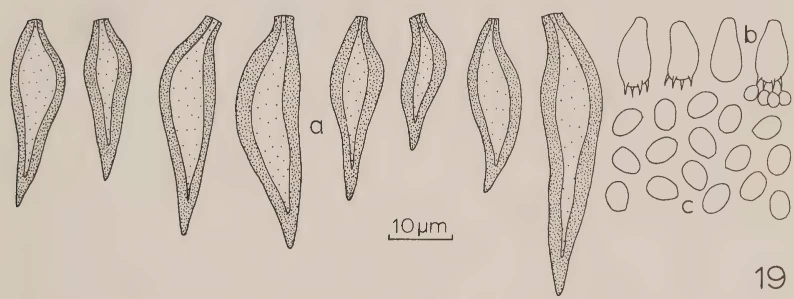
19. *PHELLINUS REPANDUS* (Overh.) Gilbn., in Lombard, et al., Mycopath. et Mycol. Appl. 46:357. 1972.
Fomes repandus Overh., Mycologia 44:224. 1952.
Basidiocarps perennial, resupinate or rarely pileate; pileus up to 3 x 8 x 3 cm; upper surface reddish brown to blackish, tomentose near the margin, becoming glabrous and incrusted, sulcate, the margin bright yellowish or yellowish brown (Ochraceous Buff to Antimony Yellow), tomentose, up to 3 mm wide, rounded; pore surface light yellowish- or grayish brown (Drab) when fresh, becoming dark reddish brown (Cinnamon-Brown to Bister) with age, usually rough to the touch, the pores circular to angular, 4-5 per mm., with thin, lacerate dissepiments; context bright yellowish brown, azonate, very soft and spongy to corky, up to 4 mm thick; tube layers paler than the context, each up to 4 mm thick, sometimes separated by a thin layer of context tissue.
Contextual hyphae of three types, some brown in KOH, thick- to moderately thick-walled, with occasional branching, rarely simple-septate, 4-7 in diam; some hyaline in KOH, thin-walled, with occasional branching, simple-septate, 2-4 in diam; others thick-walled, much branched and contorted, pale brown in KOH, aseptate, 2.5-4.5 in diam; tramal hyphae similar.
Setae rare, scattered or often concentrated in a small area, subulate or ventricose, scarcely projecting, 20-25 x 6-7.
Basidia clavate, 4-sterigmate, 9.5-10 x 4.5-5.
Basidiospores short-ellipsoid to subglobose, hyaline, smooth, negative in Melzer's reagent, 4-5.5 x 3-4.5.
Type of rot - White pocket rot of conifer logs and slash (Lombard et al., 1972).
Cultural characteristics - See Lombard et al., (1972).
Substrata - *Abies, Larix, Picea, Pinus, Pseudotsuga, Thuja, Tsuga.*
Distribution - BC, ID, MT, OR, WA.
Voucher specimens - RLG 331; RLG 954 (ARIZ).
Remarks - *Phellinus repandus* is known only from western North America but is common in some localities such as Glacier Nat. Park, Montana and the Olympia Peninsula of Washington. J. R. Weir collected this fungus several times in Idaho and Montana and identified his specimens as *Fomes putearius* Weir. His type of *F. putearius*, however, is *Phellinus nigrolimitatus*. For a detailed comparison of similar species see Lombard et al. (1972).

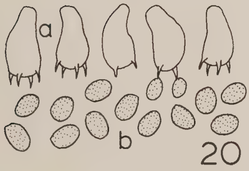
20. *PHELLINUS RIBIS* (Schum. ex Fr.) Quél., Ench. Fung., p. 173. 1886.
Polyporus ribis Schum. ex Fr., Syst. Myc. 1:375. 1821.
Fomes ribis (Schum. ex Fr.) Gill., Champ. France 1:685. 1878.
Basidiocarps sessile or slightly effused-reflexed; pilei often imbricate, applanate, up to 10 x 20 x 4 cm; upper surface at first spongy, brownish (Tawny Olive to Snuff Brown), becoming blackish, glabrous,

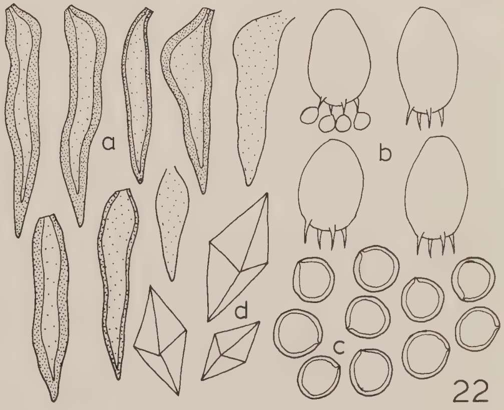












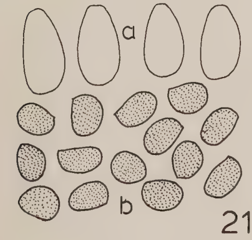


Fig. 16. *Phellinus pomaceus* (WGS 07711). a, setae; b, basidia; c, basidiospores. Fig. 17. *P. prunicola* (RLG 653). a, setae; b, basidium; c, basidiospores. Fig. 18. *P. punctatus* (RLG 6713). a, cystidioid elements; b, basidia; c, basidiospores. Fig. 19. *P. repandus* (FP 105594). a, setae; b, basidia; c, basidiospores. Fig. 20. *P. ribis* (FDJ 100). a, basidia; b, basidiospores. Fig. 21. *P. robineae* (RLG 7049). a, basidia; b, basidiospores. Fig. 22. *P. robustus* (RLG 10827). a, setae; b, basidia; c, basidiospores; d, hymenial crystals.

azonate, sulcate; margin concolorous, rounded; pore surface light brown (Snuff Brown), the pores circular to angular, 7-8 per mm, with thick, entire dissepiments; context duplex, upper layer yellowish brown, spongy, up to 2 cm thick, separated by a thin layer of black tissue from a lower pale brown layer which is corky and up to 2 mm thick; tube layers concolorous and continuous with the lower layer of the context, rather indistinctly stratified, each layer up to 2 mm thick.

Contextual hyphae of upper spongy layer of context brown in KOH solution, thin-walled, with rare branching, simple-septate, 3-6 in diam; hyphae of lower corky layer thick-walled, otherwise similar.

Setae or other sterile hymenial structures lacking.

Basidia clavate, 4-sterigmate, 9-11 x 4-5.

Basidiospores ellipsoid to ovoid, pale brownish, smooth, negative in Melzer's reagent, 3.5-4 x 2.5-3.

Type of rot - White rot of the heartwood at base of living shrubs.

Substrata - *Lonicera, Ribes,* and *Symphoricarpos.*

Distribution - AZ, CA, ID, MT, NM, OR, WA, and WY.

Voucher specimens - Weir 1676 (BPI) Weir 10198 (BPI).

Remarks - The duplex context with the layers separated by a thin but distinct layer of black tissue and the pale brownish spores characterize *P. ribis.* Ryvarden (1977) has placed this species in the genus *Phylloporia* Murr.

21. *PHELLINUS ROBINEAE* (Murr.) A. Ames, Ann. Mycol. 11(3):246. 1913.
Pyropolyporus robineae Murr., Bull. Torrey Bot. Club 30:114. 1903.
Fomes robineae (Murr.) Sacc. et D. Sacc., Syll. Fung. 17:117. 1905.

Basidiocarps perennial, sessile, applanate to ungulate, up to 30 cm wide; upper surface at first yellowish brown, finely tomentose, azonate, with age becoming black, deeply rimose, often appearing scaly, glabrous; margin at first yellowish brown, finely tomentose, in older specimens concolorous with the blackened, rimose upper surface, pore surface yellowish to reddish brown, the pores circular, 7-8 per mm, with thick, entire dissepiments; context tissue light reddish brown, azonate, woody, up to 2.5 cm thick; tube layers concolorous and continuous with the context, distinctly stratified, woody, each layer up to 3 mm thick.

Contextual hyphae brown in KOH solution, thin- to thick-walled, with rare branching, simple-septate, 2.5-5.5 in diam; tramal hyphae similar, 2.5-3.5 in diam.

Setae or other sterile hymenial structures lacking.

Basidia broadly clavate, 4-sterigmate, 10-12 x 5.5-6.

Basidiospores ovoid to subglobose, appearing flattened on one side, reddish-brown, smooth, negative in Melzer's reagent, 5-6 x 4.5-5.

Type of rot - White rot of heartwood of living black locust.

Cultural characteristics - See Campbell (1938) and Nobles (1948, 1958, 1965).

Substrata - *Robinia neomexicana, Robinia pseudoacacia.*

Distribution - AZ, CA, ID, NM.

Voucher specimens - RLG 7049; ERC 71-42 (ARIZ).

Remarks - *Phellinus robineae* is apparently present in the Southwest wherever *Robinia neomexicana* grows. Basidiocarps of *P. robineae* are similar to those of *Phellinus badius* but have smaller pores and tend to be more applanate than those of *P. badius.*

22. *PHELLINUS ROBUSTUS* (Karst.) Bourd. & Galz., Hym. France, p. 616. 1928.

Fomes robustus Karst., Finl. Basidsv., p. 467. 1889.

Basidiocarps perennial, sessile or effused-reflexed; pilei ungulate to applanate, up to 12 x 20 x 11 cm; upper surface brown to blackish, becoming incrusted and rimose, usually sulcate, glabrous; margin concolorous or yellowish brown at first, then faintly tomentose, rounded, fertile below; pore surface yellowish- or grayish brown, the pores circular, 7-9 per mm, with thick, entire dissepiments; context shining yellowish brown, zonate, hard, woody, up to 3 cm thick, core with white radial streaks present near point of attachment; tube layers distinct, light brownish, becoming whitish within, woody, each layer up to 3 mm thick.

Contextual hyphae of two types, some brown in KOH, thick-walled, rarely branched, rarely simple-septate, 2.5-4 in diam; others hyaline, thin-walled, simple-septate, 2-2.5 in diam., inconspicuous; tramal hyphae similar.

Setae lacking or occasional in some specimens, subulate to ventricose, thin- to thick-walled, 18-37 x 5-8.

Cystidia usually abundant in hymenium, hyaline, thin-walled, ventricose with narrow, tapered apex, 15-60 long and 5-7 in diam at the base, narrow apical part 1.5-2 in diam.

Basidia broadly ellipsoid, 4-sterigmate, 11-12 x 8-9.5.

Basidiospores subglobose, hyaline, smooth, thick-walled at maturity, dextrinoid in Melzer's reagent, 6-8.5 x 5.5-7.

Type of rot - White rot of heartwood of living hardwoods. On oaks in the Southwest the basidiocarps develop near the base of living trees and are associated with a butt and root rot.

Cultural characteristics - See Campbell (1938), Davidson et al. (1942) and Nobles (1948, 1958, 1965).

Substrata - *Prunus*, *Quercus*.

Distribution - AZ, CA, ID, NM.

Voucher specimens - RLG 10827; RLG 10782 (ARIZ).

Remarks - The distinctive ventricose cystidia with elongated slender apices are apparently characteristic of all the species in the *Phellinus robustus* complex. These rarely differentiate into setae but in most specimens setae are apparently absent. The concept of *P. robustus* presented here is based on pileate specimens on living oaks in the Southwest. *Phellinus punctatus* basidiocarps are resupinate and occur on dead hardwoods and conifers. *Phellinus hartigii* has reflexed basidiocarps on living conifers. *Phellinus sonorae* has resupinate to slightly effused basidiocarps at the base of *Dodonaea viscosa*.

23. *PHELLINUS SONORAE* Gilbn., sp. nov.

Fructificatio perennia, resupinata vel reflexa; pilei aureobrunnea, tomentosa; superficie porosum flavo-brunnea, pori rotundi vel angulatae, 5-7 per mm; contextus flavo-brunneus; hyphae 1.5-3 diam; cystidia abundanta, ventricosa; setae rara; basidia late-ellipsoidia, 10-11 x 7.5-8.5; basidiosporae subglobosae, hyalinae, dextrinoidae, 5-5.5 x 4.5-5. HOLOTYPUS: R. L. Gilbertson No. 10862, on *Dodonaea viscosa* Jacq., Sabino Canyon, Santa Catalina Mts., Coronado Nat. Forest, Pima County, Arizona; in herb. National Fungus Collections, Beltsville, MD, U.S.A. (BPI).

Basidiocarps perennial, resupinate to slightly reflexed; upper surface up to 8 mm wide golden brown, minutely tomentose, smooth; margin concolorous, rounded, sterile below; pore surface golden brown,

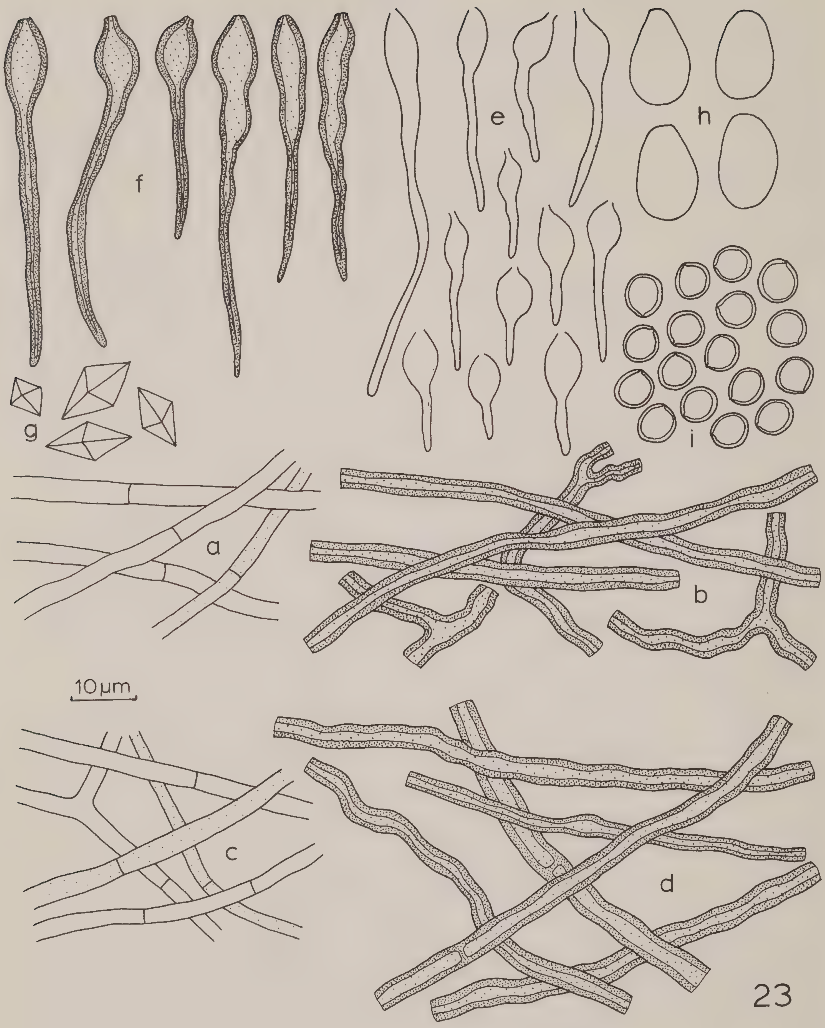


Fig. 23. *Phellinus sonorae* (RLG 10862). a, thin-walled tramal hyphae; b, thick-walled tramal hyphae; c, thin-walled contextual hyphae; d, thick-walled contextual hyphae; e, cystidioid elements; f, setae; g, crystals from hymenium; h, basidia; i, basidiospores.

smooth, glancing, the pores circular to angular, 5-7 per mm, with narrow, entire dissepiments; context bright golden brown, soft and fibrous near the margin, corky above the tube layers, azonate, up to 3 mm thick; tube layers indistinctly stratified, tubes becoming stuffed with lighter colored mycelium.

Contextual hyphae pale yellowish brown in Melzer's reagent, thin-walled to thick-walled, slender, aseptate, with rare branching, 2-7 in diam; others very inconspicuous, thin-walled, hyaline, simple-septate, 2-3 in diam; tramal hyphae closely interwoven, similar to those in context.

Setae few, developing from cystidia, ventricose with long slender apical portion, 35-55 x 5-8.

Cystidia abundant, ventricose with elongated apical portion, thin-walled, hyaline, 15-100 x 3.5-6, apical portion 1.5-3 in diam.

Basidia broadly ellipsoid, 4-sterigmate, 10-11 x 7.5-8.5.

Basidiospores subglobose, hyaline, thick-walled, smooth, dextrinoid in Melzer's reagent, 5-5.5 x 4.5-5.

Type of rot - Uniform white rot of heartwood and sapwood of hopbush (*Dodonaea viscosa*). Narrow black zone lines are conspicuous in the decayed sapwood.

Substrata - Known only on *Dodonaea viscosa* (hopbush).

Distribution - AZ. Known only from Santa Catalina Mtns., Pima County.

Voucher specimens - RLG 10862 (HOLOTYPE): RLG 10863 (ARIZ, BPI).

Remarks - *Phellinus sonorae* is a member of the *P. robustus* complex. It differs from the other species in its bright golden brown basidiocarps, smaller basidiospores, and long, narrow setae. The fact that it fruits at the base of dead or dying hopbush plants suggests it may be a root-rot pathogen.

24. *PHELLINUS TEXANUS* (Murr.) A. Ames, Ann. Mycol. 11:246. 1913.
Pyropolyporus texanus Murr., N. Amer. Fl. 9:104. 1908.

Basidiocarps perennial, sessile, ungulate, up to 15 cm wide; upper surface at first pale brown, matted-tomentose, becoming blackened and deeply rimose with age and weathering, sulcate; margin rounded, pale brown and tomentose; pore surface pale brown (Buckthorn Brown to Mummy Brown), smooth, the pores 4-6 per mm; dissepiments finely tomentose, entire; context hard and woody, yellowish brown, appearing mottled with streaks of paler tissue; tube layers stratified, Buckthorn Brown, becoming stuffed with light-colored mycelium; sections permanently darkening in KOH solution.

Contextual hyphae some thin-walled and hyaline to yellowish, with occasional septa and rare branching, 2-5 diam, others thick-walled, yellowish brown, aseptate, with rare branching, 3-5 diam; hyphae in the pale colored areas with a parallel arrangement, easily separated, hyphae in the darker areas densely interwoven, contorted, difficult to separate; tramal hyphae interwoven, pale yellowish, with slightly thickened walls and occasional septa, 2-4 diam.

Setae few, slightly thin- to thick-walled, with an inflated base to 10 diam and a slender apical portion, 25-60 long; setae apparently developing from hyaline, thin-walled cystidioid hyphal ends similar in shape and size to the setae and common in all sections.

Basidia broadly clavate to ovoid, 4-sterigmate, 17-25 x 8.5-12, the sterigmata slender, to 4 long.

Basidiospores subglobose, hyaline, strongly dextrinoid in Melzer's reagent and with distinctly thickened walls when mature, 7-9 x 6.5-9.

Type of rot - Uniform white rot of heartwood of living desert hard-

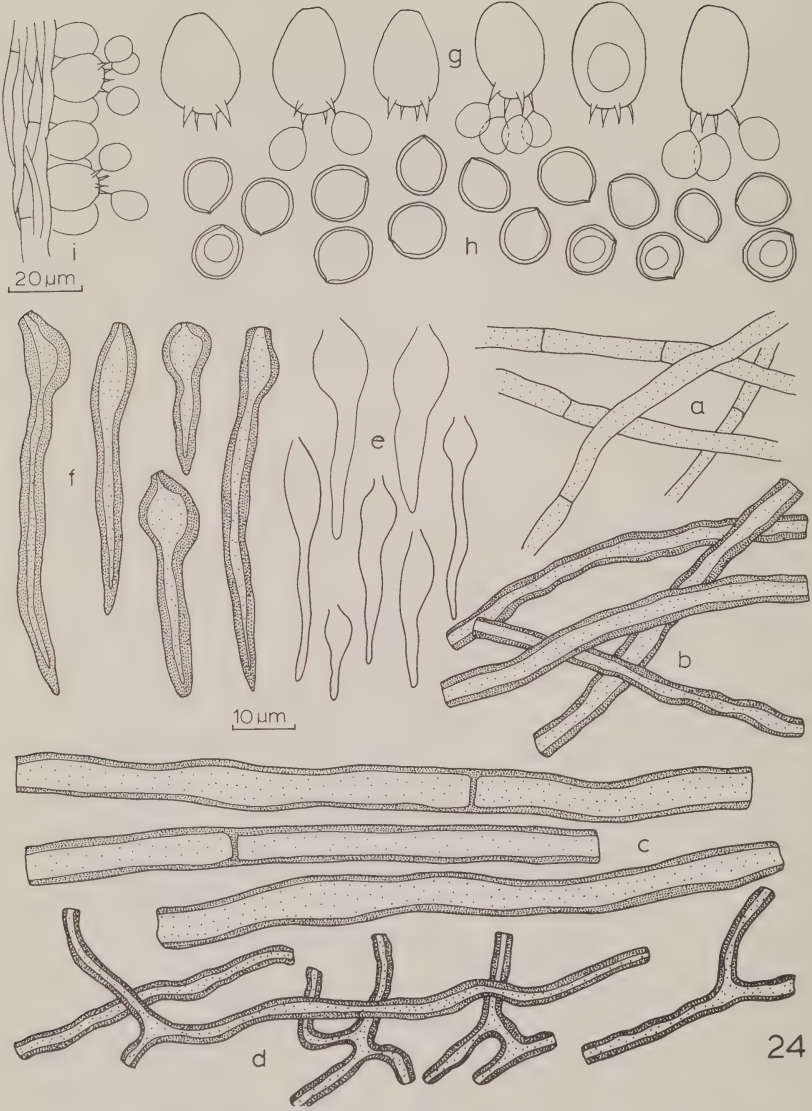


Fig. 24. *Phellinus texanus* (RLG 7406). a, thin-walled tramal hyphae; b, thick-walled tramal hyphae; c, broad, unbranched contextual hyphae; narrow, much-branched contextual hyphae; e, cystidioid hymenial elements; f, setae; g, basidia; h, basidiospores; i, schematic drawing of hymenium.

woods and junipers.

Substrata - *Canotia, Carnegiea, Celtis, Cercidium, Cercocarpus, Citrus, Cocculus, Cowania, Ephedra, Fouquieria, Juniperus, Larrea, Morus, Olneya, Opuntia, Prunus, Vauquelinia, Vitex.*

Distribution - AZ, NM.

Voucher specimens - RLG 6959; RLG 7775 (ARIZ).

Remarks - *Phellinus texanus* occurs on many Sonoran Desert trees and shrubs including cacti (Lindsey and Gilbertson, 1975; Gilbertson and Lindsey, 1975), and causes a white heartrot of living plants. Its basidiocarps are more typically ungulate than those of *P. robustus* and become more rimose with age. Setae are more frequent in *P. texanus* than in other members of the *P. robustus* complex and the basidiospores are larger.

25. *PHELLINUS TORULOSUS* (Pers.) Bourd. et Galz., Bull. Soc. Mycol. France 41:191. 1925.

Polyporus torulosus Pers., Mycol. Eur. 2:29. 1825.

Fomes torulosus (Pers.) Lloyd, Myc. Notes, Polyp. Issue No. 3:48.1910.

Basidiocarps perennial, pileate, sessile, triagular in vertical sections with the upper surface horizontal and the pore surface at approximately a 45 degree angle, applanate to thick, up to 46 cm wide, 28 cm deep, and 11 cm thick; margin obtuse, rounded, up to 2 cm thick, upper surface buff to pale brown (Cinnamon-Buff to Clay Color), glabrous to finely tomentose or slightly strigose-matted, on older portions becoming blackened, sulcate; pore surface yellowish brown (Buckthorn Brown), smooth, the pores 5-7 per mm, rounded, with thick, entire dissepiments; context yellowish brown, black in KOH solution, faintly zonate, hard and woody, up to 11 cm thick, with one or more thin, black layers that appear as fine black lines on cut or broken vertical surfaces; tube layers distinctly stratified, woody, slightly paler than context tissue.

Contextual hyphae 2.5-5 in diam, thin-walled and hyaline to moderately thick-walled and bright yellowish brown, infrequently branched, with rare septa, clamp connections absent; tramal hyphae similar;

Setae infrequent, ventricose to subulate, up to 49 long and 6-11 in diam, projecting 10-20.

Basidia clavate, 4-sterigmate, 5-6 in diam.

Basidiospores ovoid to ellipsoid, hyaline, smooth, negative in Melzer's reagent, 4-6 x 3-4.

Type of rot - White pocket rot of heartwood in roots and butt of living southwestern pine, rarely other associated conifers. The incipient stage is distinctive with bright red streaks in the normally pale heartwood.

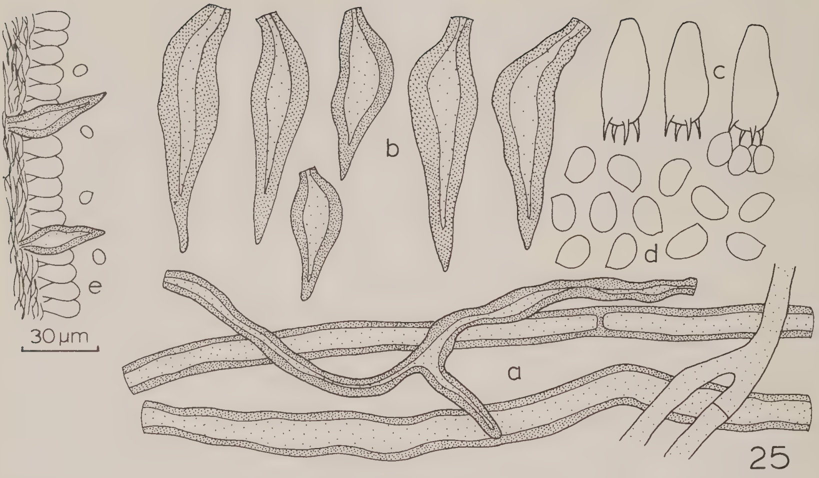
Cultural characteristics - See Gilbertson and Burdsall, 1972.

Substrata - *Pinus ponderosa, P. strobiformis, Pseudotsuga menziesii.*

Distribution - Known in North America only from the Santa Catalina and Pinaleno Mountain Ranges in southern Arizona. In these areas it is locally common on southwestern white pine.

Voucher specimens - RLG 9385; RLG 9394 (ARIZ).

Remarks - Basidiocarps of *P. torulosus* develop at the ground line on the base of the trunk or on exposed roots. It has been confused with *Phellinus gilvus* in North America but has much different cultural characteristics, slightly larger spores, and infrequent setae (Gilbertson and Burdsall, 1972). Basidiocarps of *Phellinus nigrolimitatus* may be similar to those of *P. torulosus* and both have thin black layers in the context. However, *P. nigrolimitatus* basidiocarps typically



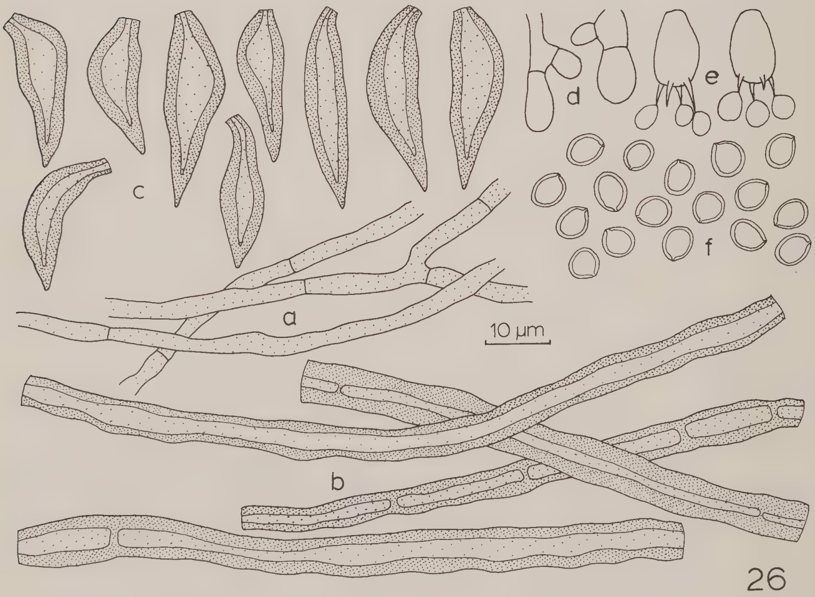
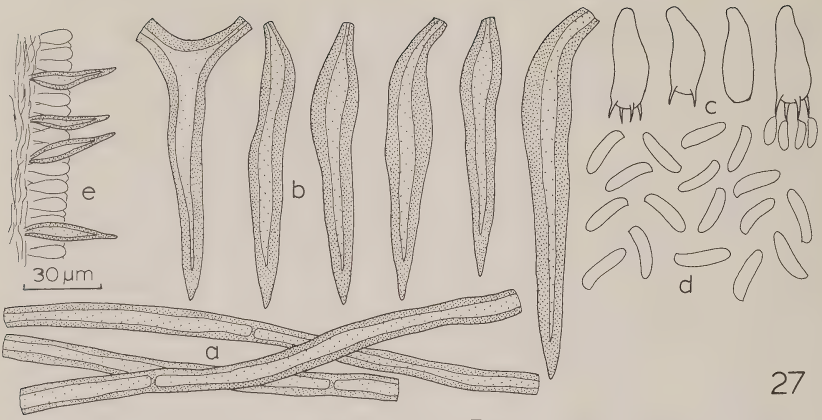


Fig. 25. *Phellinus torulosus* (HHB 1504). a, contextual hyphae; b, setae; c, basidia; d, basidiospores; e, schematic drawing of hymenium. Fig. 26. *P. tremulae* (ERC 71-92). a, thin-walled tramal hyphae; b, thick-walled tramal hyphae; c, setae; d, immature basidia; e, basidia; f, basidiospores.

develop on fallen trees and have cylindric spores and more abundant and larger setae.

26. *PHELLINUS TREMULAE* (Bond.) Bond. et Boriss., in Bond., Polyporaceae Eur., USSR and Caucasia. p. 358. 1953.
Fomes igniarius f. *tremulae* Bond., Fungi in the Bryansk Forest. p. 22. 1912.
Basidiocarps perennial, sessile, developing at branch scars, up to 20 cm wide and 15 cm thick, triangular in longitudinal section with the pore surface and upper surface at angles of about 45° from the horizontal axis, woody, attached to the host by a granular core of tissue that is continuous into the decayed branch stub; upper surface pale brown (Wood Brown to Clay Color) near the margin, finely tomentose, soon becoming blackened, crust-like, and rimose; pore surface purplish brown (Natal Brown), the pores circular, 6-7 per mm, with thick, entire dissepiments; context dark reddish brown, woody, with a granular core at the place of attachment; tube layers indistinctly stratified, tubes becoming stuffed with white mycelium, each tube layer up to 2 mm thick.
Contextual hyphae simple-septate, thin-walled and pale yellowish to almost hyaline, 2-3 in diam, or thick-walled, dark reddish brown, 4-6 in diam; granular core composed of densely interwoven, branching hyphae with clusters of thick-walled, dark reddish brown, irregularly shaped and contorted cells; tramal hyphae with parallel arrangement.
Setae few to numerous, thick-walled, ventricose to subulate, 12-30 x 6-7, projecting to 15.
Basidia broadly ovoid, 4-sterigmate, 8-10 x 6-7, simple-septate at the base.
Basidiospores subglobose, hyaline, smooth, negative in Melzer's reagent, with thickened wall at maturity, 4.5-5 x 4-4.5.
Type of rot -White trunk rot of living trees and a major decay fungus throughout the range of aspen (Lindsey and Gilbertson, 1978). It is restricted to aspen. Wikstrom (1976) reported that *Phellinus tremulae* in *Populus tremula* spread in the inner sapwood and inner wood of living trees in the absence of other organisms, indicating that it is a primary parasite in aspen.
Cultural characteristics - See Nobles (1948, 1958, 1965, as *Fomes igniarius* var. *populinus*); Hopp (1936 as *Fomes igniarius*); Verrall (1937, as *Fomes igniarius*).
Substrata - *Populus tremuloides*.
Distribution - AK, AT, AZ, BC, CA, CO, ID, MT, NM, OR, UT, WA, WY, probably wherever aspen grows in western North America.
Voucher specimens - RLG 4877; JPL 212 (ARIZ).
Remarks - *Phellinus tremulae* has not been segregated from the *Phellinus igniarius* complex by some American authors (Overholts, 1953; Lowe 1957), and referred to by others as *Fomes igniarius* var. *populinus* (Campbell, 1938; Nobles, 1948, etc.). Niemalä (1974) gives a thorough account of the basidiocarp and cultural morphology of *P. tremulae*. Besides the macroscopic difference in basidiocarps, *P. tremulae* is microscopically different from other members of the *P. igniarius* complex included here because of the parallel arrangement of its tramal skeletal hyphae. Culturally it differs in the slow growth rate and sweet wintergreen odor.

27. *PHELLINUS VITICOLA* (Schw. apud Fr.) Donk, Persoonia 4:342. 1966.
Polyporus viticola Schw. apud Fr., Elenchus 1:115. 1828.



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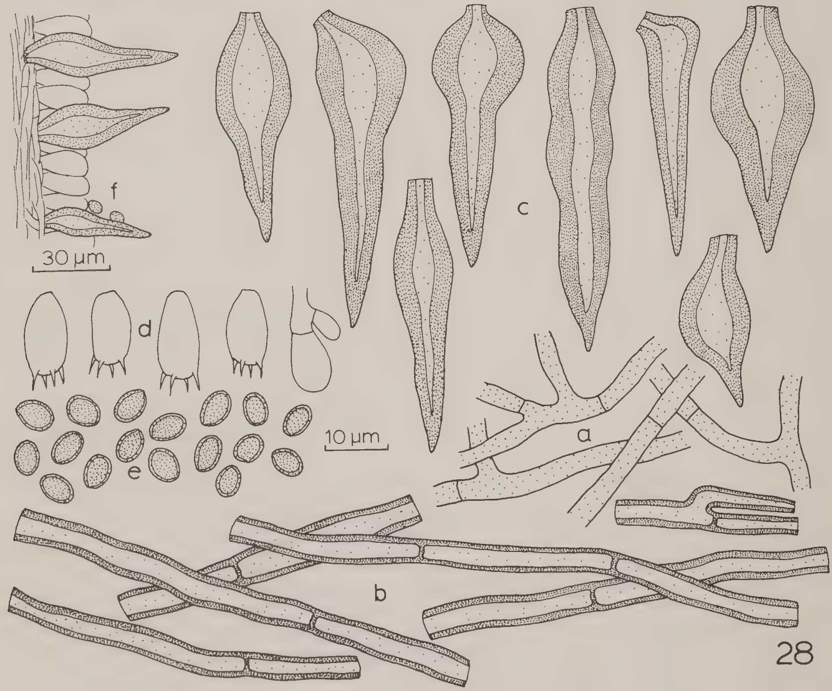

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Fig. 27. *Phellinus viticola* (RLG 8026). a, tramal hyphae; b, setae; c, basidia, d, basidiospores; e, schematic drawing of hymenium. Fig. 28. *P. weirianus* (RLG 7776). a, thin-walled contextual hyphae; b, thick-walled contextual hyphae; c, setae; d, basidia; e, basidiospores; f, schematic drawing of hymenium.

Fomes viticola (Schw. apud Fr.) Lowe, State Univ. New York College of Forestry Tech. Publ. 80, p. 45. 1957.
Fomes tenuis Karst., Soc. Fauna Flora Fenn. Meddel. 14:81. 1887.
Trametes setosus Weir, Jour. Agr. Res. 2:164. 1914.
Basidiocarps perennial, usually effused-reflexed, often sessile or entirely resupinate, often developing by fusion of two or more; pilei generally dimidiate or narrow and shelflike, up to 1.5 x 6 x 1 cm; resupinate specimens often effused up to 30 cm; upper surface reddish brown to blackish, hirsute to almost glabrous, sulcate; margin usually lighter reddish brown, tomentose to hirsute, acute or rounded; pore surface yellowish brown (Brussels Brown), the pores circular to angular, 4-7 per mm, with thick, entire dissepiments; context yellowish brown, faintly zonate, corky-fibrous, up to 3 mm thick; tube layers concolorous and continuous with the context, up to 5 mm thick, the tubes usually whitish within.
Contextual hyphae of two types, some brown in KOH, thick-walled, rarely simple-septate, 2-3 in diam, others pale yellowish brown to hyaline in KOH, thin-walled, with occasional branching, simple-septate, 2-3 in diam; tramal hyphae similar.
Setae abundant, narrowly subulate, 25-75 x 5-8.
Basidia clavate, 4-sterigmate, 9-10 x 5-6, simple-septate at the base.
Basidiospores cylindric, straight or curved, hyaline, smooth, negative in Melzer's reagent, frequently biguttulate, 5.5-8 x 1.5-2.
Type of rot - Uniform white rot of dead wood of conifers and hardwoods.
Cultural characteristics - See Nobles (1948, 1958, 1965), Campbell (1938), Davidson et al. (1938) and Baxter (1937).
Substrata - Abies, Acer, Alnus, Larix, Picea, Pinus, Populus, Pseudotsuga, Quercus, Thuja, Tsuga.
Distribution - AK, AZ, BC, CA, CO, ID, NM, MT, OR, YT, WA, and WY.
Voucher specimens - RLG 6072; RLG 2058 (ARIZ).
Remarks - When entirely resupinate *P. viticola* may be distinguished from similar brown porias by its long narrow setae and narrow cylindric spores. Shope (1931) called this fungus *Trametes isabellina* Fr., and the resupinate form has been called *Poria isabellina* (Fr.) Overh.

28. *PHELLINUS WEIRIANUS* (Bres.) Gilbn., J. Ariz. Acad. Sci. 7:137.1972.
Fomes weirianus Bres., Studi Trentini 2:7(1):55. 1926.
Basidiocarps perennial, sessile, usually ungulate; upper surface becoming blackened and rimose, sulcate; margin golden brown (Antimony Yellow), finely tomentose, rounded, up to 1 cm wide; pore surface golden brown (Buckthorn Brown), smooth, the pores circular, 5-7 per mm, with thick, entire dissepiments; context yellowish brown, faintly zonate, hard, fissile, up to 4 cm thick; tube layers concolorous, not clearly distinct, up to cm thick.
Contextual hyphae pale to dark brown in KOH solution, thin- to thick-walled, frequently simple-septate, with rare branching, 3-5 in diam.
Setae frequent to scattered, subulate to ventricose, 20-52 x 7-14.
Basidia broadly clavate, 4-sterigmate, 10-12 x 6-7, simple-septate at the base.
Basidiospores subglobose to ovoid, pale yellow, smooth, negative in Melzer's reagent, 4-5 x 3-3.5.
Type of rot - White heartrot of living walnut.
Substrata - Juglans major.
Distribution - AZ, NM, MEXICO.
Voucher specimens - RLG 7353; RLG 6975 (ARIZ).
Remarks - Phellinus weirianus has a limited distribution but is common

p. 86

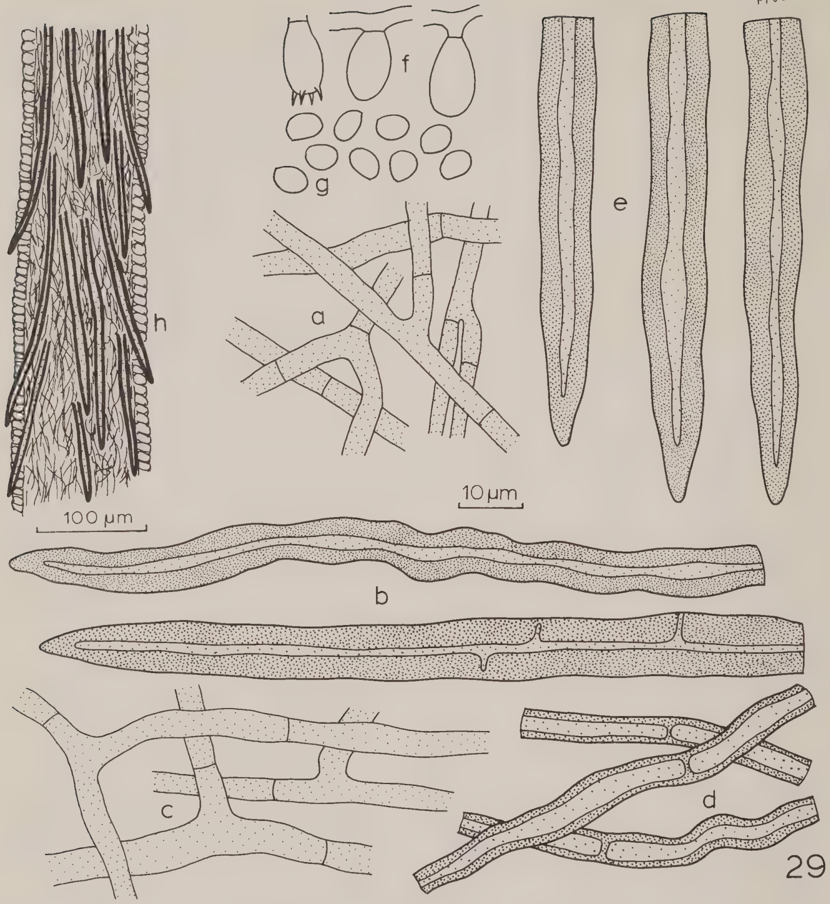

Fig. 29. *Phellinus weirii* (RLG 400). a, thin-walled tramal hyphae; b, setal hyphae; c, thin-walled contextual hyphae; d, thick-walled contextual hyphae; e, projecting tips of setal hyphae; f, basidia; g, basidiospores; h, schematic drawing of hymenium.

in southern Arizona wherever walnut grows. It is similar to *P. everhartii* which is restricted to oaks. Setae of *P. weirianus* are much larger than those of *P. everhartii.*

29. *PHELLINUS WEIRII* (Murr.) Gilbn., Fungi that decay ponderosa pine, p. 170. 1974.
Fomitiporia weirii Murr., Mycologia 6:93. 1914.
Poria weirii Murr, Mycologia 6:93. 1914.

Basidiocarps perennial or annual, becoming extensively effused, very light in weight, not readily separable; margin pale brown (Cinnamon or Sayal Brown), soft, fimbriate, up to 2 cm wide; pore surface slightly darker brown (Natal Brown or Verona Brown), the pores circular to angular, 5-7 per mm, with thick, setulose dissepiments that become thin and lacerate; context yellowish brown, soft, fibrous, spongy, azonate, up to 1 cm thick; tube layers light grayish brown, brittle, each layer up to 5 mm thick.

Contextual hyphae of three types, some pale yellowish-brown in KOH, thin-walled, with frequent branching, simple-septate, 2.5-5.5 in diam; some darker brown in KOH, thick-walled, 3-5.5 in diam; setal hyphae dark reddish brown, thick-walled, with rare branching, aseptate, traceable to a tapering, pointed tip, 6-10 in diam; tramal hyphae similar, setal hyphae projecting into tubes.

Setae abundant, formed by projecting setal hyphae pointing toward the tube opening, 6-10 thick, projecting up to 70.

Basidia clavate, 4-sterigmate, 10-11 x 5-5.5.

Basidiospores ovoid, hyaline, smooth, negative in Melzer's reagent, 5.5 x 4.5.

Type of rot - Yellowish laminated rot of the roots and butt of living conifers. Important as a heart rot of western redcedar and as a root rot of second growth Douglas fir and true firs. In the advanced stages of decay, brown mycelium becomes conspicuous between the layers of wood. Setal hyphae are abundant in this mycelium.

Cultural characteristics - See Baxter (1953), Davidson et al. (1938), and Nobles (1948, 1958, 1965).

Substrata - Thuja, Pseudotsuga, Abies, Chamaecyparis, Larix, Picea, Pinus, and Tsuga.

Distribution - AK, BC, ID, MT, OR, and WA.

Voucher specimens - RLG 400; ERC 75-18 (ARIZ).

Remarks - The light, soft context and marginal tissue, the hyaline, ovoid spores, and the conspicuous setal hyphae are important characters of *P. weirii*. *P. ferrugineofuscus* is similar but has narrow, cylindric spores and the tramal setal hyphae that project into the hymenium with the tips curved and perpendicular to the axis of the tube.

ACKNOWLEDGMENTS

This work was supported by McIntire Stennis funds through the University of Arizona Agricultural Experiment Station. Field work in the northern Rocky Mountains, western Canada, and Alaska was also supported by NSF Grants G24382 and GB 7120. Use of herbarium facilities and loan of specimens from the National Fungus Collections, Beltsville, MD (BPI); The New York Botanical Garden, New York, NY; and the Center for Forest Mycology Research, U.S. Forest Service, Forest Products Laboratory, Madison, WI (CFMR) is gratefully acknowledged. I have studied a number of *Phellinus* species in previous research with J. Page Lindsey, and she has contributed substantially to the preparation of figures

and text material in this paper. It has been a particular privilege and pleasure to work with her on North American wood-rotting fungi. I also appreciate the association with several other colleagues with whom I have studied *Phellinus* species - particularly J. L. Lowe, H. H. Burdsall, Jr., Frances F. Lombard, E. R. Canfield, and R. W. Davidson.

LITERATURE CITED

Baxter, D. V. 1934. Some resupinate polypores from the region of the Great Lakes. V. Mich. Acad. Sci. Arts Lett., Papers 19:305-332.

________ 1937. (same title) VIII. *Ibid.* 22:275-295.

________ 1945. (same title) XVI. *Ibid.* 30:175-191.

________ 1952. (same title) XXIII. *Ibid.* 37:93-110.

________ 1953. (same title) XXIV. *Ibid.* 38:115-123.

Bondarzew, A. 1953. Pore fungi of the European part of the USSR and of the Caucasus. 1106 p. Leningrad.

Boyce, J. S. and J. W. B. Wagg. 1955. Conk rot of old-growth Douglas-fir in western Oregon. Oregon Forest Products Lab. Bull. 4. 96 p.

Campbell, W. A. 1938. The cultural characteristics of the species of *Fomes*. Torrey Bot. Club Bull. 65:31-69.

Canfield, E. R. and R. L. Gilbertson. 1978. A comparative study of three *Phellinus* species. Manuscript in preparation.

Davidson, R. W., W. A. Campbell, and D. J. Blaisdall. 1938. Differentiation of wood-decaying fungi by their reactions on gallic or tannic acid medium. J. Agric. Res. 57:683-695.

________, W. A. Campbell, and D. B. Vaughn. 1942. Fungi causing decay of living oaks in the eastern United States and their cultural identification. U.S. Dept. Agr. Tech. Bull. 785. 65 p.

Domanski, S., H. Orłos, and A. Skirgiełło. 1967. Basidiomycetes: Aphyllophorales: Polyporaceae pileatae, Ganodermataceae, Bondarzewiaceae, Boletopsidaceae, Fistulinaceae. In Flora Polska (Grzyby) 3, 398 p. 92 figs., 29 pls.

Donk, M. A. 1960. The generic names proposed for Polyporaceae. Persoonia 1(2):173-302.

________ 1964. A conspectus of the families of Aphyllophorales. Persoonia 3(2):199-324.

________ 1974. Check list of European polypores. Verhand. Kon. Nederl. Akad. Wetsch. afd. Nat. II, 62. 469 p.

Fritz, C. W. 1923. Cultural criteria for the distinction of wood-destroying fungi. Trans. Roy. Soc. Can. 17:191-288.

Gilbertson, R. L. and H. H. Burdsall, Jr. 1972. *Phellinus torulosus* in North America. Mycologia 64(6):1258-1269.

________ and J. P. Lindsey. 1975. Basidiomycetes that decay junipers in Arizona. Great Basin Nat. 35(3):288-304.

Hopp, H. 1936. Appearance of *Fomes igniarius* in culture. Phytopathology 26:915-917.

Jahn, H. 1967. Die resupinaten *Phellinus*-arten in Mitteleuropa. Westf. Pilzbr. 6:37-124.

________ 1976. *Phellinus hartigii* (All. & Schn.) Pat. und *Ph. robustus* (P. Karst.) Bourd. & G. *Ibid.* 11:1-15.

Kimmey, J. W. and J. A. Stevenson. 1957. A forest disease survey of Alaska. Plant Dis. Reptr. Supp. 247, p. 87-98.

Lindsey, J. P. and R. L. Gilbertson. 1975. Wood-inhabiting homobasidiomycetes on saguaro in Arizona. Mycotaxon 2:83-103.

________ 1978. Basidiomycetes that decay aspen in North America. Bibliotheca Mycologica, Band 63. J. Cramer. 406 p., 12 pl.

Lohwag, K. 1937. *Fomes hartigii* (Allesch.) Sacc. et Trav. und *Fomes robustus* Karst. Ann. Mycol. 35:339-349.

Lombard, F. F., R. W. Davidson, and R. L. Gilbertson. 1972. Studies of two species of *Phellinus* in western North America. Mycopath. et Mycol. Appl. 46:351-365.

Lowe, J. L. 1957. Polyporaceae of North America. The genus *Fomes*. State Univ. N.Y. Coll. Forestry Tech. Publ. 80. 183 p.

________ 1966. Polyporaceae of North America. The genus *Poria*. State Univ. N.Y. Coll. Forestry Tech. Publ. 90. 183 p.

Niemalä, T. 1972. On fennoscandian polypores. II. *Phellinus laevigatus* (Fr.) Bourd. & Galz. and *P. lundellii* Niemalä, n. sp. Ann. Bot. Fenn. 9:41-59.

________ 1974. On fennoscandian polypores. III. *Phellinus tremulae* (Bond.) Bond. et Boriss. *Ibid.* 11:202-215.

________ 1975. On fennoscandian polypores. IV. *Phellinus igniarius, P. nigricans and P. populicola*, n. sp. *Ibid.* 12:93-122.

________ 1977. On fennoscandian polypores. 5. *Phellinus pomaceus*. Karstenia 17:77-86.

Nobles, M. K. 1948. Studies in forest pathology. VI. Identification of cultures of wood-rotting fungi. Can. J. Res., C. 26:281-431.

________ 1958. Cultural characters as a guide to the taxonomy and phylogeny of the Polyporaceae. Can. J. Bot. 36:883-926.

________ 1965. Identification of cultures of wood-inhabiting Hymenomycetes. Can. J. Bot. 43:1097-1139.

Overholts, L. O. 1953. Polyporaceae of the United States, Alaska, and Canada. Univ. Michigan Press, Ann Arbor. 466 p.

Owens, C. E. 1936. Studies on the wood-rotting fungus, *Fomes pini*. I. Variations in morphology and growth habit. Amer. J. Bot. 23:144-149.

Ridgway, R. 1912. Color standards and color nomenclature. Washington, D.C. Published by the author.

Ryvarden, L. 1977. The Polyporaceae of North Europe. Vol. 2. *Inonotus-Tyromyces*. Fungiflora, Oslo. 507 p.

Shope, P. F. 1931. The Polyporaceae of Colorado. Missouri Bot. Gard. Ann. 18:287-456.

Verral, A. F. 1937. Variation in *Fomes igniarius* (L.) Gill. Univ. Minn. Agr. Exp. Sta. Tech. Bull. 117. 41 p.

Wikstrom, C. 1976. The occurrence of *Phellinus tremulae* (Bond.) Bond. et Boriss. as a primary parasite in *Populus tremula* L. Eur. J. For. Path. 6:321-328.

ADDENDUM

After this paper was completed and submitted, a pertinent publication by F. Kotlaba and Z. Pouzar (Notes on *Phellinus rimosus* complex [Hymenochaetaceae]. Acta Bot. Croat. 37:171-182. 1978) came to my attention. In this paper the authors report that the fungus included here as *Phellinus badius* is correctly named *Phellinus rimosus* (Berk.) Pilát. They propose to restrict the name *P. badius* to another species represented only by the type specimen.

MYCOTAXON

Vol. IX, No. 1, pp. 90-92 June 12, 1979

SYNAPTONEMAL COMPLEXES IN THE GAMETANGIA OF *SAPROMYCES ANDROGYNUS* (LEPTOMITALES, OOMYCETES)

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INTRODUCTION

Most major textbooks on mycology have assumed the Oömycetes to have a haploid vegetative state with meiosis occurring upon germination of the diploid zygote. Sansome (1961), working with *Pythium*, found evidence for meiosis in the gametangia and suggested the possibility that all Oömycetes might be diploid with only a brief haploid phase in the gametangia. Most recent investigations, especially electron microscopic studies, have supported this position (Dick and Win-Tin, 1973; Ellzey and Huizar, 1977).

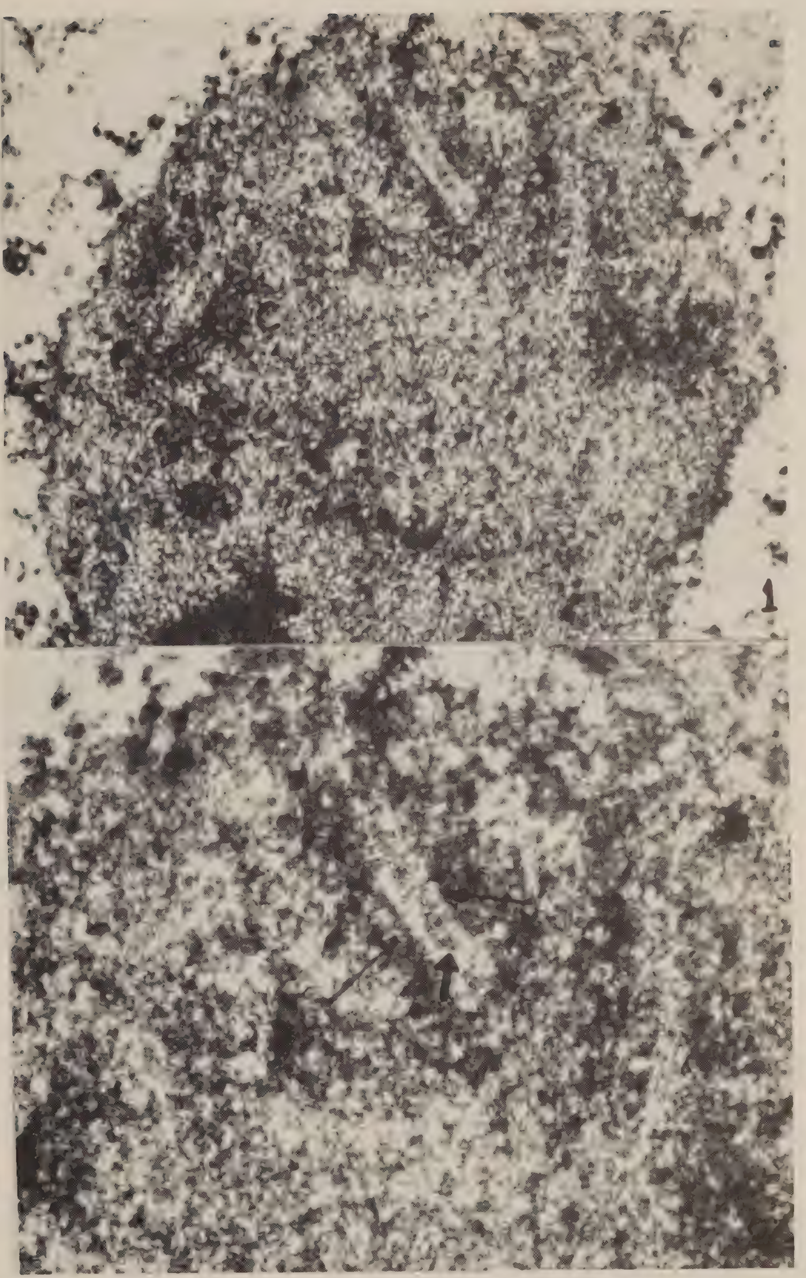
Ultrastructural evidence comes from the observation of synaptonemal complexes. These structures have been identified as being indicators of meiosis (Moses, 1964) and have been found in the gametangia of the Saprolegniales and Peronosporales (Ellzey and Huizar, 1977). This paper presents evidence of their presence in the third order, the Leptomitales, providing further support to the conclusions that the Oömycetes are diploid.

METHOD AND MATERIALS

A culture of *S. androgynus* was obtained from Ralph Emerson and the events of the life cycle were studied in detail with both light and electron microscopy (Gotelli, 1977).

Fig. 1. Nucleus in oögonium showing synaptonemal complexes and condensed chromatin (C). X 40,000.

Fig. 2. Synaptonemal complexes, one in longitudinal view showing lateral elements (long arrows) and central element (heavy arrow). X 84,000.



RESULTS

Synaptonemal complexes are found in developing oögonia (Fig. 1) of *S. androgynus*. Most of these structures are associated with condensed chromatin and appear to terminate at the nuclear membrane. Closer examination (Fig. 2) shows the classical structure of paired lateral elements and a central, slightly accentric element.

LITERATURE CITED

Dick, M. W., and Win-Tin. The development of cytological theory in the Oömycetes. Biol. Rev. 48:133-158. (1973).

Ellzey, J. T., and E. Huizar. Synaptonemal complexes in antheridia of *Achlya ambisexualis* E87. Arch. Microb. 112:311-313. (1977).

Gotelli, D. An ultrastructural study of *Sapromyces androgynus* (Thaxter). 2nd International Mycol. Congress (Abs.). (1977).

Moses, M. J. The nucleus and chromosomes: a cytological perspective. pp. 423-558. In: Cytology and cell physiology (G. H. Bourne, ed.) New York: Acad. Press, 1964.

Sansome, E. R. Meiosis in the oögonium and antheridium of *Pythium debaryanum* Hesse. Nature, Lond. 911:827-828. (1961).

MYCOTAXON

Vol. IX, No. 1, pp. 93-113 June 12, 1979

NEW AND INTERESTING TAXA OF *RUSSULA* PERS. EX S.F. GRAY OCCURRING IN WASHINGTON STATE

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This paper considers three taxa of *Russula* collected in western Washington during the fall months of 1962. Two new species (*R. viridofusca, R. stuntzii*) and one variety (*R. rosacea* var *macropseudocystidiata*) are described as new. These three russulas are uncommon or rare in Washington State.

Species of *Russula* Pers. ex S.F. Gray occur abundantly in western Washington and are a conspicuous element of the agaric flora in the forests of the state. During the four years I examined the *Russula* flora for a Ph.D. thesis, under the supervision of D.E. Stuntz, I found a number of new and unusual taxa. The taxa included in this paper represent several of the more uncommon russulas examined during my studies.

In the descriptions, color terms are cited from three sources. Terms from Ridgway (1912) are enclosed in quotation marks, those from Kornerup and Wanscher (1962) are designated thus: 5B6, and those from the National Bureau of Standards (Kelly and Judd, 1955) are designated thus: ISCC 56. Other color terms, usually used to describe general coloration, are my own. Spore color was taken from mature spores in deposit, and color terms are those of Crawshay (1930).

Collection numbers designated ACAD refer to collections deposited in the E.C. Smith Herbarium, Acadia University. Microscopical data and camera lucida drawings, as well as the scanning electron photomicrographs were taken from the nomenclatoral type.

Scanning electron microscopes used in this study were the JEOL J.S.M. U3 located in the Electron Microprobe Analyzer Laboratory, Department of Materials and Metallurgical Engineering, University of Michigan, and the JEOL

J.S.M. 25 located in the Department of Biology, Acadia University. Secondary electron images were recorded on Polaroid Type 55 P/N 4 X 5 film. Coating was accomplished at the Electron Microprobe Analyzer Laboratory with a glow discharge coater at six minute pulse coating with 100% gold at 200-300 Angstrom units thick, and at the Acadia Electron Optics Laboratory with a Technics Hummer II coater at three-minute pulse coating with gold/palladium at 200-300 Angstrom units of thickness. Spores were mounted on adhesive copper tape (3-M) directly from the spore deposit. The tape was glued to a JEOL mounting stub with Duco cement (Dupont product).

Secondary electron images taken on the JEOL J.S.M. U3 were made with 15 KV accelerating voltage, and those taken on the JEOL J.S.M. 25 were made using 25 KV.

Russula viridofusca Grund, sp. nov.

Etym: viridi = green; fuscus = sombre brown L.

Pileus 5-11.5 cm latus, convexus, planoconvexus, deinde convexo-depressus, marginem tuberculatus striatus; viscidus diende siccus, glaber; olivaceus, viridiolivaceus, olivaceosubalinus versus olivaceocitrinus; caro albida, mollis, mutabilis ad ferrugineus; odor suavis, gustus mitus. Lamellae adnexae, confertae, cremeae. Stipes 4.5-8.5 cm longus, 1.8-2.6 cm crassus, siccus, glaber, albus, mutabilis ad ferrugineus, basi subalbosus. Sporae (9)10-13 X 8-10 µm, in cumulo cremeae, globulosae vel ellipsoideae; ornamentatione amyloideae, 0.5-1.1 µm alta, echinatae. Subcutis pilei 100-140 µm crassi ex hyphis conjunctivis gelatinosis intertextis. Epicutis pilei 40-70(100) µm crassi, trichodermium, adpressum, implicatum formans. Pseudocystidia hymenii 66-112 X 11-14 µm, subclavatae ad subventricosa, ope sulfovanillinae atrantia.

Holotypus ACAD 12867, in sylvis coniferis prope Tahoma Creek, comitato Pierce, Washingtoni; holotypus in herbario Universitatis Acadiae (ACAD).

Figs 1, 4, 5

Basidiocarp: Pileus 5-11.5 cm broad, broadly convex when young, becoming plane and finally centrally depressed with margins broadly arched and rounded to uplifted; margins tuberculate-striate; pellicle separating from one-third to one-half the radius of cap; surface viscid, soon drying dull, glabrous overall; color variable, generally olive green or sepia to ochre colors, the center usually darker; 4F2 olive; "Dark Olive"; (ISCC 96) to 4C6 blond; "Dark Olive Green"; (ISCC 88) at center shading to 4C8 deep yellow 4E4 olive brown; "Dark Citrine"; (ISCC 95) or 4F4 sepia; "Dark Olive"; (ISCC 96) at margins; "Yellow Ochre"; (ISCC 84), context 7-15 mm thick off the disc, pallid to creamy in color, firm when young becoming soft at maturity, bruising rusty-brown, taste mild, odor not distinctive. Lamellae mostly equal, lamellulae infrequent; adnate; moderately close, rarely forking; color 4A3 pale yellow "Light Buff"; (ISCC 89). Stipe 4.5-8.5 cm long, 1.8-2.6 cm thick, flared at apex, then mostly equal or expanding at base; surface minutely longitudinally rugulose, dry, glabrous; color white, bruising bright rusty-brown when injured, staining brown when handled; context firm, solid, pallid, cream, unchanging when cut cleanly but bruising rusty-brown when injured.

Macrochemical Reactions: Pileal flesh; 40% formaldehyde - pale pink to pinkish-vinaceous, guaiac tincture - deep blue, 10% $FeSO_4$ - olive color or dull buff that darkens with time, guaiacol - rusty red, sulphovanillin - slightly lavender or negative reaction, sulphoformol - negative reaction, 10% pyrogallol - bright reddish brown, aniline water - bright red, a-naphthol - negative or sometimes lightly purple, phenol-aniline - brown becoming black, 2% phenol - deep reddish-brown. Hymenial pseudocystidia; sulphovanillin - contents of cell stained purple to purple-black.

Microscopic Structures: Spores cream ("B" Crawshay) in deposit; under optical microscope (9)10-13 X 8-10 µm, globose to subglobose, ornamentation echinate, consisting of acutely convex or conic warts and protruberances, 0.5-1.1 µm high, a few connectives and ridges between projections that do not appear to form a partial reticulum, suprahilar area usually a plage consisting of an amyloid patch of irregular surface and minute projections: under scanning electron microscope, protruberances, subcylindric, conic to low convex, laterally flattened, apices acute to rounded, ornamentation arising from a glabrous spore wall in some spores or a wall with a minute system of connectives between the bases of the projections; suprahilar area a slightly raised plage with a smooth, slightly irregular surface with an irregular lobed or slightly dentate margin. Basidia 36-52 X 11-15 µm, subcylindric, subclavate to clavate, thin-walled, 2 or usually 4-spored, hyaline to light brown in KOH, ochre in Melzer's Reagent. Hymenial pseudocystidia 66-112 X 11-14 µm subclavate, fusoid-clavate, fusoid-ventricose to subcylindric, apices acuminate to lanceolate; thin-walled; projecting 30-40 µm beyond basidioles, abundant. Subhymenium 40-50 µm thick, mostly pseudoparenchymatous. Cuticle composed of epicutal and subcutal layers; epicutis 40-70(100) µm thick, consisting of an appressed trichodermium, epicutal terminal cells sometimes pilocystidia 55-90 X 6-12 µm; subclavate to subfusoid-ventricose, apices acuminate, thin-walled, or usually short clavate cells 20-40 X 10-12 µm; subcutis consisting of a gelatinous interwoven hyphae, mostly 2-4 µm thick that form a layer 100-140 µm thick. Surface of

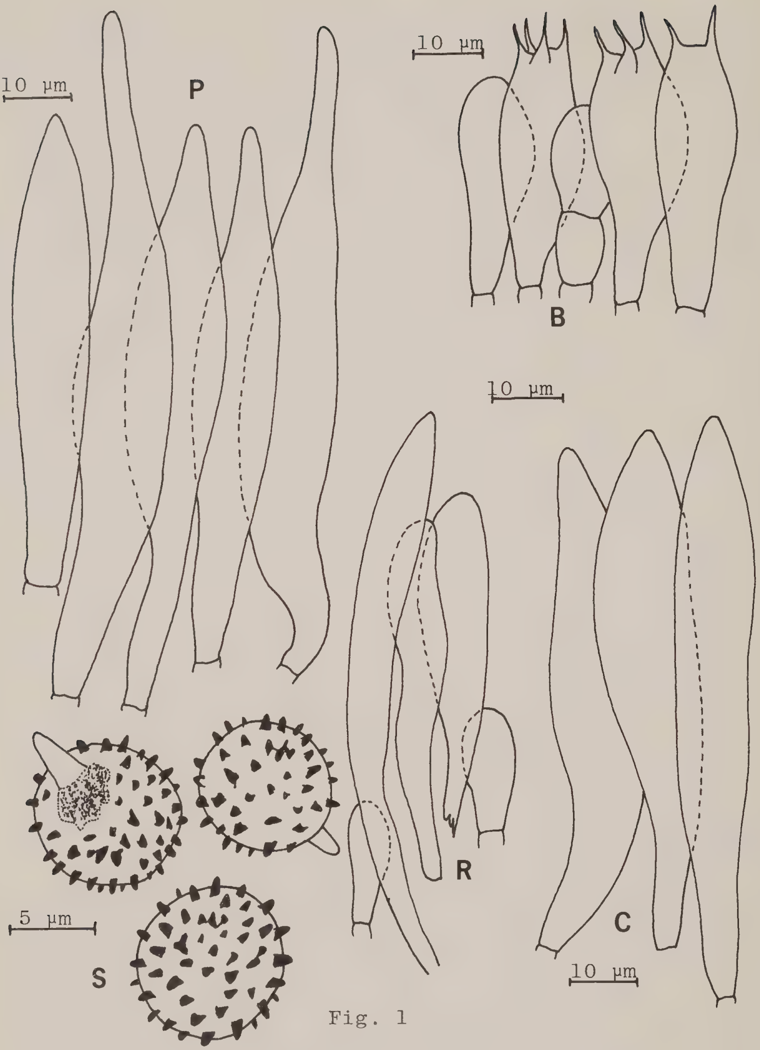


Fig. 1

R. viridofusca

Symbols for Figs. 1-3: P = pseudocystidia on sides of lamellae (pleurocystidia), C = pseudocystidia on edges of lamellae (cheilocystidia), R = epicutal pseudocystidia, B = basidia and basidioles, D = terminal cuticular hyphae of stipe (caulocystidia), S = spores.

stipe of interwoven hyphae, the terminal hyphae cylindric, hyaline, 3-5 µm thick, non-gelatinous, vascular elements not observed. Dermatocaulocystidia absent.

Habit and Habitat: Solitary, occurring in coniferous forests, especially under hemlock. *Tsuga heterophylla* (Raf.) Sarg.

Material Examined: ACAD 12867 (Holotype) Tahoma Creek, Mt. Rainier National Forest, Pierce Co.; October 21, 1962; Acad 12866, White River Valley, Washington; October 14, 1962.

Observations: *Russula viridofusca* Grund is a member of Section *Polychromae* R. Maire, Subsection *Viridantinae* Melzer-Zvara (sensu Romagnesi, 1967), and exhibits the group characteristics of echinate spore ornamentation, bruising reactions, and macrochemical reactions of $FeSO_4$ and aniline water with context. This species does not have the typical fishy-shrimpy odor of trimenthylamine so characteristic of *R. xerampelina* Sing. and its varieties. The macrochemical reaction of aniline water (aniline oil and distilled water 1:1 v/v) with context is deep red, which is distinctive as Subsection *Viridantinae* normally shows a reddish or reddish brown reaction. *R. viridofusca* is closely related to *R. cicatricata* Romagn. but differs from the later in spore size (7.7-8.5(9.2) X 6.5-7.7 µm for *R. cicatricata*), and the morphology of the cuticular terminal cells. Romagnesi (p 95, 1967) does not mention a deep-red macrochemical reaction with aniline water for *R. cicatricata*. *R. viridofusca* differs from *R. elaeodes* Bres. in that the latter has smaller spores, smaller pileus, and the typical fishy odor of the subsection. *R. furcata* (Lam. ex Fr.) Pers. ex Fr. superficially resembles *R. viridofusca* in the olive color of the pileus, but has much smaller spores (6.5-8.5 µm, Crawshay, plate 1, 1930), and differs in the sectional characteristics. *R. heterophylla* Fr. var *chlora* (Gill.) Kuhn & Romagn. is a green russula with the general appearance of *R. viridofusca* but differs in spore size and morphology, and sectional characters.

This is a rare russula in Washington and was collected twice during the three years I examined the russula flora.

Russula stuntzii Grund, sp. nov.

Pileus 3.5-8.3 cm latus, convexus, planoconvexus, diende depressus vel ascendens, marginem tuberculatus striatus; viscidus diende politus, glaber; albidus, pallidus; caro albida, firma, immutabilis; odor suavis; sapor valde acris. Lamellae adnexae, confertae, albida. Stipes 3.0-7.5 cm longus, 0.9-2.2 cm crassus, glaber, albidus, immutabilis. Sporae (7.5)8-9.5 X 7-7.5(8) μm, in cumulo albida, globosae, ornamentatione amyloideae, 0.8-1.5 μm alta, echinatae et reticulatae compositae non altae porcatae. Subcutis pilei 100-120(140) μm, ex hyphis conjunctivis gelatinosis intextis et hyphis vascularibus constans. Epicutis pilei 80-100(140) μm, e ixotrichodermium; pseudocystidia 80-140(160) X 5-8 μm, subclavatae. Pseudocystidia hymenii 36-108 X 7.5-12.5 μm, subclavatae ad subventricosa, ope sulfovanillinae atrantia.

Holotypus ACAD 12868, in sylvis coniferis prope Barlow Pass, Washingtoni; holotypus in herbario Universatis Acadiae (ACAD).

Figs 2, 6, 7, 8

Basidiocarp: Pileus 3.5-8.3 cm broad, at first broadly convex, then plane and finally depressed at center with broadly rounded or uplifted margins; margin tuberculate striate, pellicle separable at margins; surface viscid, glabrous, drying polished and shining; color pallid with a slight purplish component, more or less dingy or dull white in appearance. The center may be grayish-white overall with lighter patches (the pallid colors above not properly represented in the standard color references); context 0.3-1.0 cm thick off the disc, white, unchanging when cut or bruised, firm taste strongly acrid, odor not distinctive or absent. Lamellae adnate or slightly adnexed, moderately close, rarely forking, occasionally lamellulae interspersed; color cream to almost white. Stipe 3.0-7.5 cm long, 0.9-2.2 cm thick, mostly equal to slightly expanded at base and immediately at apex where lamellae attach; surface glabrous, longitudinally rugulose, moist; color white, not bruising but sometimes darkening slightly grayish upon handling; context white, unchanging when cut or bruised, rind firm, pith soft and not hollowing.

Macrochemical Reactions: Pileal flesh; 40% formaldehyde - negative; guaiac tincture - deep blue, 10% $FeSO_4$ - flesh color; guaiacol - dark red; sulphovanillin - purple; sulphoformol - purplish to brown, aniline water - negative to slightly yellowish; a-naphthol - deep violet; pyrogallol - rusty brown; phenol - aniline - deep reddish brown; 2% phenol - deep reddish brown. Hymenial pseudocystidia; sulphovanillin - contents of cell stained purple to purple-black.

Microscopic Structures: Spores white ("A" in Crawshay) in deposit: under optical microscope 8.0-9.5(10.0) X 7.0-7.5(8) μm, globose to subglobose or rarely short elliptic; ornamentation echinulate, consisting of conic protruberances 0.8-1.5 μm high, some connected by thin lines forming an incomplete reticulum, suprahilar area a plage that appears to be composed of amyloid granular material on a flat pane: hyaline in KOH, ornamentation strongly amyloid in Melzer's Reagent; under scanning electron microscope, ornamentation consisting of flattened or conic protuberances mostly 1-1.3(.5) µm high, connected by ridges 0.2-0.4 µm high and low connectives 0.1 µm high, that form nearly a complete reticulum, plage slightly raised above spore wall, irregular in outline, consisting of a system of shallow areolae to a submerulioid configuration, apical diverticule cylindric with rounded apex. Basidia 38-48 X 10-12 µm, subclavate to clavate, thin-walled, light brownish in KOH, mostly 4-spored. Hymenial pseudocystidia on the sides of lamellae 60-108 X 8.4-12 µm; mostly subcylindric to subclavate or sometimes subfusoid, apices rounded, mucronate to acuminate; projecting 25-40 µm beyond basidioles; slightly browning in KOH, contents highly granular; abundant. Subhymenium poorly defined when present, approximately 15-20 µm thick, consisting of subparallel hyphae 2-3 µm thick. Tramal mediostratum composed of mostly parallel hyphae with parenchymatous cells intermixed, lactiferous hyphae abundant. Cuticle composed of epicutal and subcutal layers; epicutis an ixotrichodermium, 80-100(140) µm thick, consisting of pileal pseudocystidia 80-140(160) X 5-12 µm that are mostly thin-walled subcylindric cells with rounded apices, and highly gelatinized interwoven connective hyphae and interspersed vascular or lactiferous hyphae; subcutis 100-140 µm thick, consisting mostly gelatinized hyphae 2-3(5) µm thick. Surface of stipe consisting of interwoven hyphae, caulopseudocystidia 35-80 X 5-15 µm, that are thin-walled, clavate, subcylindric to ventricose with granular contents, and vascular hyphae that are mostly 4-5 µm thick.

Habit and Habitat: Solitary, occurring in coniferous forests, typically under hemlock, *Tsuga heterophylla* (Raf.) Sarg. and Douglas fir, *Pseudotsuga menziesii* (Mirbel) Franco.

Material Examined: ACAD 12868 (Holotype), Barlow Pass, Washington, October 20, 1962; ACAD 10269, White River Valley, Pierce Co., Washington, October 14, 1962.

Observations: This new species is apparently a member of Section *Russula* Subsection *Emeticinae* Melzer and Zvara (sensu Singer, 1962). *R. albida* Pk. resembles *R. stuntzii*, but differs in its mild or slighter bitter taste, yellowish color at center of pileus, hollow stipe, and the cuticle separating halfway to center (Beardslee, 1918). *R. anomala* Pk. differs from *R. stuntzii* in spore morphology that is echinulate without connectives forming a reticulum (Singer, 1943), dry, buff pileal surface, and the macrochemical reactions of $FeSO_4$ and formaldehyde (Singer, 1947). *R. stuntzii* closely resembles *R. albidula* Pk. in color, taste, pileal surface, spore size and ornamentation except in spores of the latter which are maize yellow in

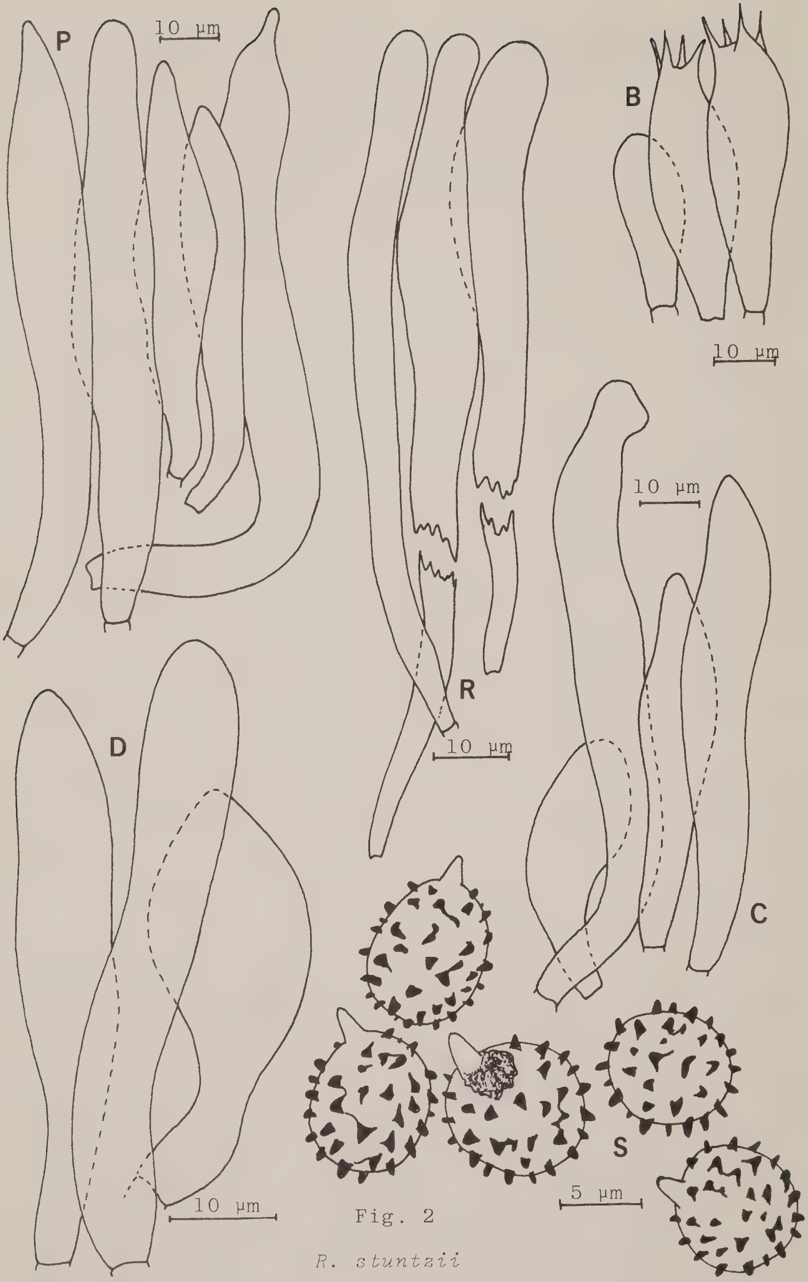

P
10 µm
R
10 µm
B
10 µm
10 µm
C
D
10 µm
S
5 µm

Fig. 2

R. stuntzii

deposit (Beardslee, 1918; Burlingham, 1915). Again, *R. albiduliformis* Murr. has the same basidiocarp characteristics and spore morphology as *R. stuntzii*, but differs from the latter in pale pinkish salmon spore color in deposit (near "B" of Crawshay, in Singer, 1947). *R. maculosa* Murr. usually has brownish or dark ochre colors on a cracked dry pileal surface (Singer, 1947). *R. albella* Pk. differs from this new species because of its dry pileal surface that is sometimes tinged with pink or rosy red, and its mild taste (Peck, 1897). *R. innocura* has deep colored spores (Singer, 1962) and mild taste (Singer, 1943). *R. crenulata* Burl. superficially resembles *R. stuntzii*, but differs in pileal color, spore morphology, and certain macrochemical reactions, especially a-naphthol, that shows a weak reaction.

R. pantoleuca Singer, a rare mushroom first collected on Mount Wachusetts, Mass., is phylogenetically the closest relative to *R. stuntzii*, both belonging to Subsection *Emeticinae*. *R. pantoleuca* differs in its pileal color that is apparently more yellowish white, mild taste of context, the pileal cuticle that is separable over most of the cap, odor of apples (weakly), and its occurrence under *Betula*, *Quercus*, and *Fagus* (Singer, 1958).

R. stuntzii is a beautiful and striking russula. It was collected only twice during the three years I examined the Washington flora, and I did not find any collections of it in the University of Washington herbarium. It is, like its relative *R. pantoleuca* Singer, a rare mushroom.

Russula rosacea (Pers.) Fr.

Nat. Arr. 1: 618, em. Fries, Epicrisis p. 351, 1838.

var. *macropseudocystidiata* var. nov.

Etym: macro = long, large, in Gk; pseudo = resembling but not equaling, in Gk.

Pileus 6.5 cm latus, convexodepressus, umbonatus, marginem tuberculatus striatus; viscidus diende politus, glaber; ruber; caro albida, immutabilis, odor suavis, sapor valde acris. Lamellae adnexae, confertae, cremeae. Stipes 5.0 cm longus, glaber, roseus, immutabilis. Sporae 7.5-9.5(12) X 6.5-8.5 µm, in cumulo cremeae, ornamentatione amyloideae, 0.5-0.8(1.0) µm alta, echinatae. Pseudocystidia hymenii 30-120 X 8.4-18 µm, subclavatae, ope sulfovanillinae atrantia.

Holotypus ACAD 12870, in sylvis coniferis prope Tohoma Creek, comitato Pierce, Washingtoni; holotypus in herbario Universitatis Acadiae (ACAD).

Figs 3, 9, 10

Basidiocarp: Pileus 6.5 cm broad, centrally depressed with small umbo, margins broadly rounded appearing subplane to nearly uplifted, tuberculate striate, pellicle separable only at edge of margin; surface viscid, drying shining and polished, glabrous; color generally strawberry red at center, shading to currant red at the margins; 10D8 cardinal red; "Pompeian Red"; (ISCC 17) at center shading to 10C8 turkey red; "Nopal Red"; (ISCC 13) at margins; context 0.6 cm thick off the disc, white, firm, unchanging, taste strongly acrid, odor not distinctive. Lamellae adnate, rarely forking, moderately close, color cream, lamellulae infrequent. Stipe 5.0 cm long, 1.2 cm thick, expanding slightly towards base; surface glabrous, minutely longitudinally rugulose; color white at apex becoming strongly washed with red at base, appearing pinkish red to red in localized areas; context white, soft, unchanging, rind firm and rigid.

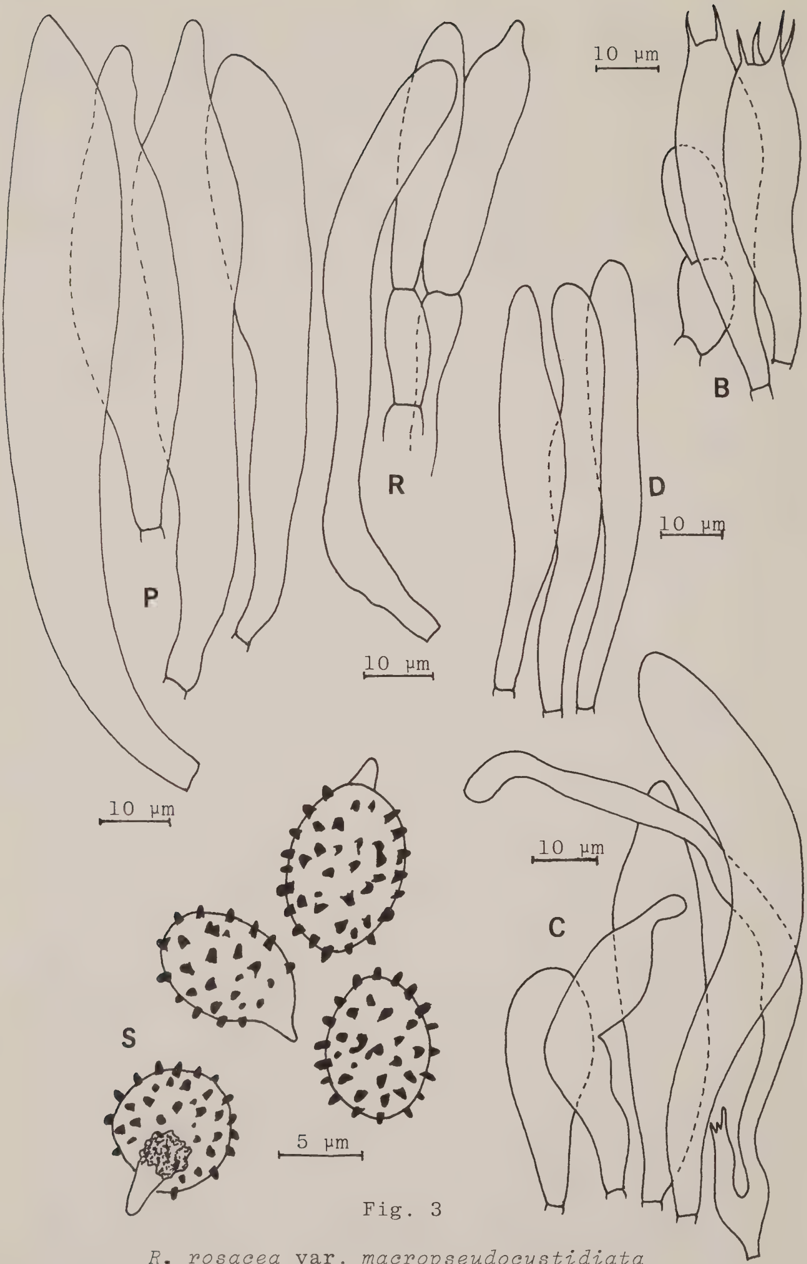
Macrochemical Reactions: Pileal flesh; 40% formaldehyde - negative; guaiac tincture - blue; 10% $FeSO_4$ - brownish; Guaiacol - vinaceous; sulphovanillin - deep purple; sulphoformol - at first brown, then gray and finally black; pyrogallol - rusty brown; aniline water - reddish; a-naphthol - purple; phenol-aniline - vinaceous brown; 2% phenol - brown. Hymenial pseudocystidia; sulphovanillin - contents of cell stained strongly purple-black.

Microscopic Structures: Spores cream ("Cream, B" in Crawshay) in deposit; under optical microscope 7.5-9.5 (12) X 6.5-8.5(9) μm, mostly oblong to occasionally subglobose; ornamentation echinulate, consisting of conic to round protruberances and sometimes isolated heavy ridges, mostly 0.5-0.8(1.0) μm high, amyloid; suprahilar area a plage that appears almost smooth and stained nearly solid purple by the amyloid reaction in Melzer's Reagent; hyaline in KOH: under scanning electron microscope, ornamentation consisting of several types of protruberances, some flat and conic, some subcylindric to nearly truncate and flattened, some subcylindric with expanded and bulbous apices, and others forming irregular ridged projections that appear to be two or more protruberances that developed adnately and became fused together; most protruberances isolated and not connected by ridges or connectives, but some with definite connecting ridges forming a slight rudimentary reticulum in localized areas, ornamentation mostly 0.6-0.9(1.5) cm high; plage a flat, smooth, slightly raised platform, the edges of which are slightly inrolled, surface slightly irregular with low bosses, margin undulate to nearly entire, apical diverticule cylindric with round or truncate apices. Basidia 36-54 X 9.0-12 μm, subcylindric to subclavate, thin-walled, two or 4-spored, hyaline in KOH, brownish in Melzer's Reagent. Hymenial pseudocystidia on the sides of lamellae 60-120 X 12-18 μm, mostly subcylindric or subclavate, some almost fusoid, apices acutely rounded to subrostrate, arising from subhymenium, projecting 12-25 µm beyond basidioles; those on the edges of the lamellae 30-120 X 8.5-13.0 µm, variously shaped from cylindric to clavate, apices rounded, thin-walled; all pseudocystidia with intracellular contents grayish in KOH, those without hyaline, abundant. Subhymenium poorly differentiated, consisting of a narrow zone of mostly filamentous hyphae and some sphaerocysts approximately 8-12 µm thick; lamellar trama composed of sphaerocysts and connective hyphae, mostly 2-3 µm thick; vascular hyphae interspersed. Cuticle composed of epicutal and subcutal layers; epicutis consisting of a poorly differentiated layer of gelatinous hyphae not truely an ixotrichodermium, 100-140 µm thick, gelatinized appressed hyphae mostly 3-5 µm thick, hyaline in KOH: vascular hyphae interspersed and abundant, mostly 4-5(6) µm thick; no clamps observed; pileal pseudocystidia mostly imbedded in epicutal layer, 60-130 X 6-8 µm, mostly clavate or cylindric, apices rounded or rostrate, grayish in KOH, abundant. Subcutal layer 60-80(100) µm thick, yellowish-brown in KOH, composed of filamentous, thin-walled (3)4-5 µm thick, radially oriented; no clamps observed; entire layer not well differentiated from pileal context excepting brownish color when mounted in KOH. Surface of stipe consisting of interwoven hyphae and numerous caulopseudocystidia, mostly 40-60(80) X 6-8(10) µm, subcylindric to clavate, apices rounded, thin-walled, gray in KOH because of intracellular contents: vascular hyphae abundant, mostly 4-6 µm thick.

Habit and Habitat: Solitary, occurring in coniferous forests of mixed hemlock *Tsuga heterophylla* (Raf.) Sarg. and Douglas fir *Pseudotsuga menziesii* (Mirbel) France . This one collection was made at the upper campground on Tohoma Creek, Mount Rainier National Park, Pierce County.

Material Examined: ACAD 12870 (Holotype) Tahoma Creek, Pierce Co., Washington; October 20, 1962.

Observations: This new variety of *R. rosacea* is distinctive because of the polished and shining pileal surface when dry, and the longer hymenial pseudocystidia (53-88 X 9-15 µm for the typical variety). The typical variety may be slightly to moderately viscid when wet, but dries to a dull, glabrous surface. Singer's (p. 245, 1958) description indicates the epicutal layer of the pileus to be composed of filamentous, non-gelatinous hyphae, but does mention a "scanty gelatinous mass" in the cutis-like hypoderm. This would account for the viscidity when wet. This new variety has a reasonably thick, highly gelatinized epicutal layer and would appear to differ considerably from the typical form. Singer (loc. cit) examined numerous collections from Europe, Philippine Islands, Asia, and North America when he thoroughly described *R. rosacea* and certainly well understood the species and any variations. However, it is interesting to note that Massee (p. 36, 1902) described *R. sanguinea* Fr. (now *R.*


10 μm
B
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S
5 μm

Fig. 3

R. rosacea var. *macropseudocystidiata* *rosacea*) as having a "polished" pileus.

I am hesitant to describe new taxa based on a single collection; however, several excellent examples exist where such descriptions have been most useful. One of these is *Boletus huronensis* Smith and Thiers. This taxon is rare in Michigan and was first described (Smith, p. 306, 1971) from one collection. Not until Smith's description, could we identify a common and locally abundant bolete occurring in Nova Scotia, which was *Boletus huronensis*.

ACKNOWLEDGMENT

I wish to thank Dr. Robert L. Shaffer, Professor of Botany and Curator of the Herbarium, University of Michigan, and Dr. K.A. Harrison, Research Associate, Acadia University for their review of this paper, and Dr. Harrison for his assistance in obtaining scanning electron photomicrographs. This investigation was supported by research grants (A-2826) and (E-3951) from the National Research Council of Canada, Ottawa.

LITERATURE CITED

Beardslee, C. H. 1918. The Russulas of North Carolina. J. Elisha Mitchell Sci. Soc. 33: 147-197.

Burlingham, G. S. 1915. *Russula* Pers. N. Amer. Fl. 9: 201-236.

Crawshay, R. 1930. The Spore Ornamentation of the Russulas. Baillière, Tindall and Cox. London. 174 pp.

Kelley, K. L. and D. B. Judd. 1955. The ISCC-NBS method of designating colors and a dictionary of color names. National Bureau of Standards Circ. 553. Washington, D.C. 158 pp.

Kornerup, A., and J. H. Wanscher. 1962. Reinhold Color Atlas. Reinhold Publ. Co. N.Y. 224 pp.

Massee, G. 1902. European Fungus Flora: Agaricaceae. Duckworth and Co. London. 274 pp.

Peck, C. H. 1897. Report of the State Botanist. From the 50th report N.Y. State Mus. 50: 77-159.

Ridgway, R. 1912. Color standards and color nomenclature. Publ. privately, Washington, D.C. 43 pp. and 53 pls.

Romagnesi, H. 1967. Les Russules d'Europe et d'Afrique du Nord. Bordas. Paris. 998 pp.

Singer, R. 1943. Type studies on Basidiomycetes II. Mycologia 35: 142-163.

―――――― 1947. Type studies on Basidiomycetes III. Mycologia 39: 171-189.

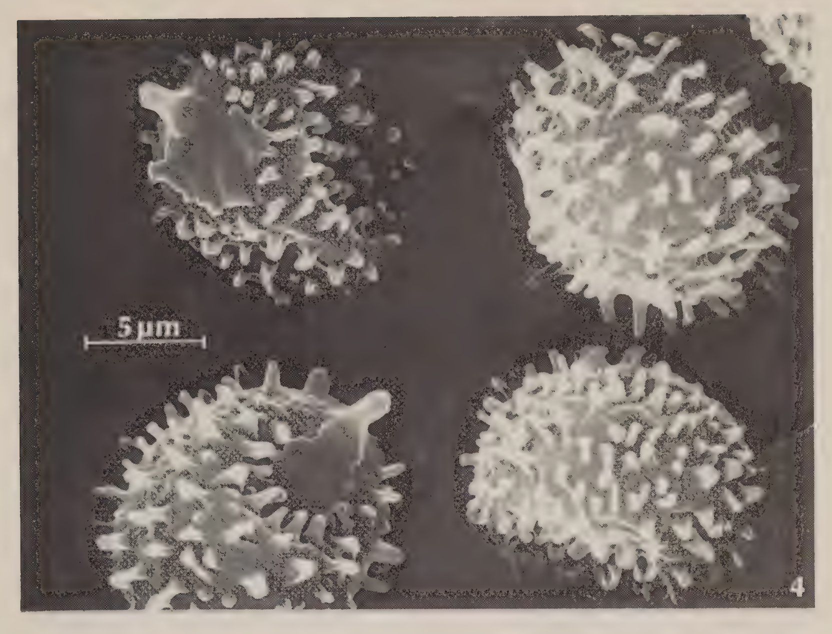
―――――― 1958. New and interesting species of Basidiomycetes V. Sydowia 11: 141-272.

―――――― 1962. The Agaricales in Modern Taxonomy. J. Cramer. Weinheim. 915 pp., 73 pls.

Smith, A. H. and H. D. Thiers. 1971. The Boletes of Michigan. Univ. of Mich. Press. Ann Arbor. 428 pp., 157 pls.

Figs. 4 and 5

R. viridofusca



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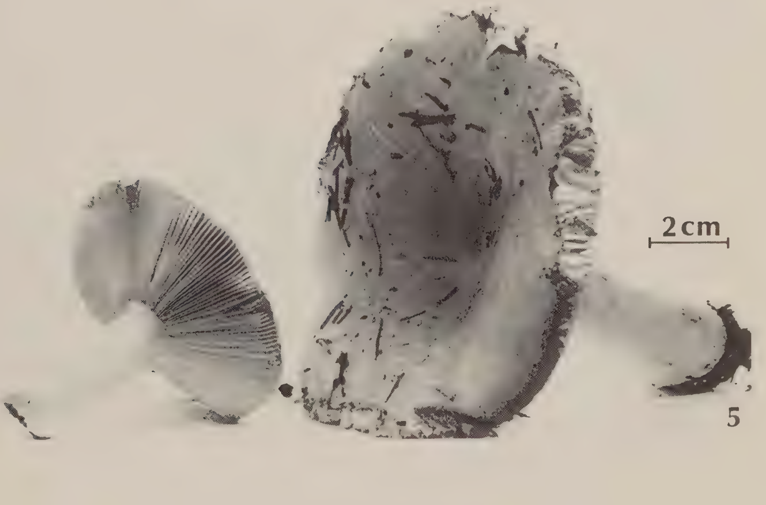

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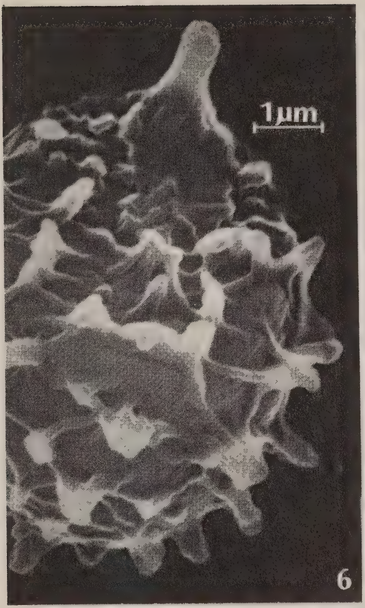
Figs. 6, 7, and 8



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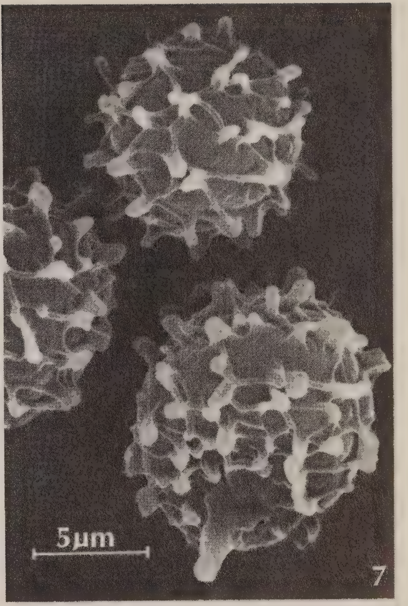

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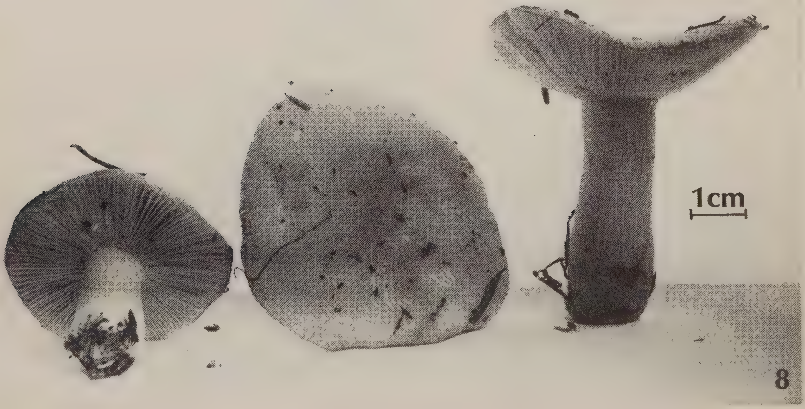

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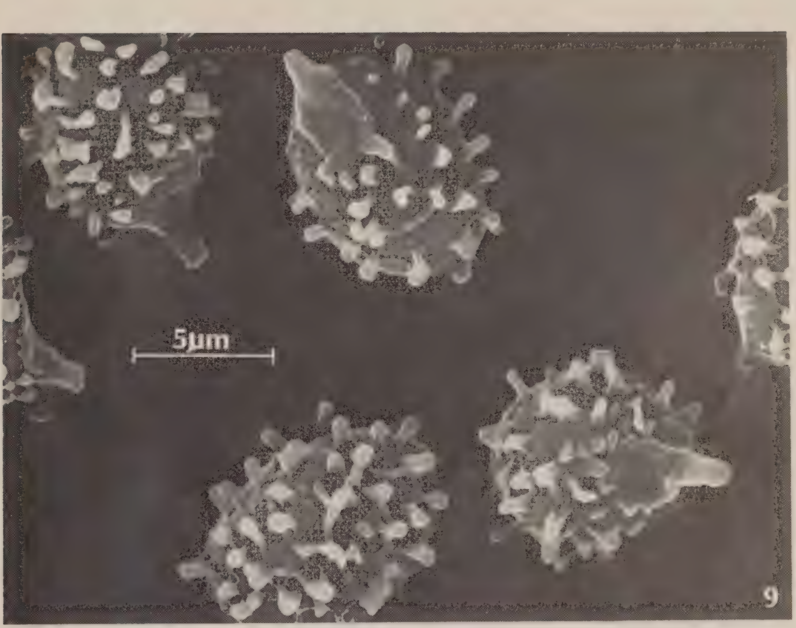
Figs. 9 and 10

R. rosacea var. *macropseudocystidiata*



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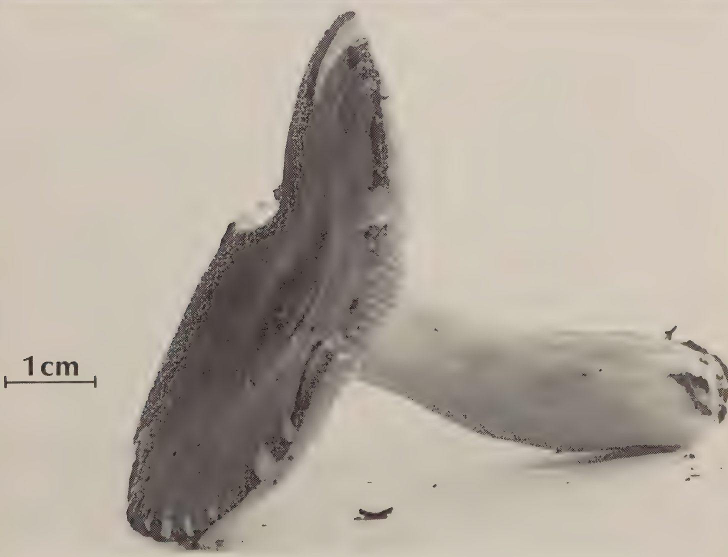

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MYCOTAXON

Vol. IX, No. 1, pp. 114-116 June 12, 1979

NEOTYPE SELECTION FOR *AGARICUS ASPRELLUS* FR.

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Two interpretations of *Agaricus asprellus* Fr. (= *Leptonia asprella* (Fr.) Quél.) exist in agaricological literature (Orton, 1960; Kühner & Romagnesi, 1953). In order to clarify which interpretation was acceptable, I studied several authentic collections of *Agaricus asprellus* or *Leptonia asprella* at the Royal Botanic Gardens in 1973. These collections were obtained through the assistance of Dr. R. Santessan from Upsala, Sweden.

Two descriptions of these collections are provided. One is based on a collection made by O. Rob. Fries in 1860 which is the oldest, verified collection of *Agaricus asprellus* and which I am proposing as the neotype collection for that species. The second description is a composite one based on several collections made by Lundell et al between 1946 and 1948.

Neotype study of *Agaricus asprellus*

Spores 8.6 - 11.2 x 5.9 - 7.7µm, average length 9.6µm, average width 6.8µm, elongate-angular, L-D 2.0 - 4.0µm (average 2.8µm), 5-6-sided. Basidia 26.4 - 30.0 x 7.9 - 11.2µm, clavate, 4-spored. Cheilocystidia and pleurocystidia absent. Gill trama subparallel, hyphae up to 4.5µm wide. Pileipellis not observed (see comments); pileocystidia napiform to clavate, 22.4 - 51.2 x 9.6 - 17.6µm, average length 34.3µm, average width 13.8µm, Lt/Dt 1.6 - 3.8(average); penultimate cells 6.4 - 9.6µm wide, Lt/Dl 2.3 - 5.8. Stipitipellis mostly a cutis, hyphae repent, but at the apex with scattered clusters of clavate, basidia-like, caulocystidia, 32.0 - 48.0 x 8.0 - 12.8µm; stipe trama hyphae up to 16.0µm. Lactifers absent. Pigmentation vacuolar in all parts and at times in the form of dark globules. Clamp connections absent on all parts.

Material studied: NEOTYPE. Fungi Sueici. Upl. Upsaliae in campis aridis; 8/1860; leg. and det. by O. Rob. Fries - #287 (in pencil) as *Agaricus asprellus*.

This collection consists of seven carpophores glued and flattened on a card with mosses at the base of the basidiocarps. The gills were dark colored on one, tinged pinkish on the others; the pileus had a central depression and striations were apparent; the stipe appeared concolorous with the pileus. Due to the age of the collection, the pileipellis did not revive well; however, some of the hyphae of the pileipellis did revive after squashing a piece of the pileus in 3% KOH and the size and shape of the pileocystidia were observed.

Specimens that I've studied in the past which possess similarly shaped pileocystidia have a hymeniform pileipellis, at least on the pileus disc. This is also verified after studying material, identified as *Leptonia asprella* by Lundell, which match Fries' material in all features.

Leptonia asprella (Fr.) Quél. s Lundell

Spores 8.9 - 10.6 x 5.9 - 7.9µm, average length 9.8µm, average width 6.9µm, elongate-angular, L-D 2.1 - 3.3µm (average 2.9µm), 5-6-sided. Basidia 29.0 - 39.6 x 9.2 - 11.9µm, clavate, 4-spored. Cheilocystidia and pleurocystidia absent. Pileipellis of three layers; suprapellis ± hymeniform, cells forming a trichodermial palisade, often with the hyphae agglutinated, terminal cells one to two per penultimate cell, clavate to broadly clavate, 28.8 - 86.4 (-112.0) x 9.6 - 25.6(-30.4)µm, average length 56.0µm, average width 18.4µm, Lt/Dt 2.4 - 4.9(average 3.0), penultimate cells inflated, 6.4 - 11.2µm, Lt/Dl 2.6 - 11.0; mediopellis of inflated, parallel to slight entangled, anticlinally oriented (on the disc) hyphae; subpellis of anticlinally oriented hyphae but much more entangled than mediopellis, not inflated. Stipitopellis mostly a cutis but at the apex with rare to scattered clusters of clavate, basidia-like caulocystidia, 16.0 - 52.0 x 6.4 - 12.8µm. Lactifers absent. Pigmentation vacuolar in all parts, at time, particularly in older collections, very dark. Clamp connections absent on all parts.

Material Studied. Grässlänt invid landsväg. Blekinge: Augerum sn, ca 300 sw om Bastasjö gard; 13 Sept 1946; Lundell 46 (herb. #2364); Västmanland: Sala Stad, Vom Barnelund Vägkant. 1499, 25 July 1953; Lundell 55; Pa betesvall Smaland: Femsjö s:n, strax S.W. om Prägstgarden; 22 Sept 1949; S. Lundell & J. Stordal, 3072; Pagammal, mossig betesmark. Smaland: Femsjö s:n, Nyby (ödetorp); 18 Sept 1949; S. Lundell & J. Stordal, 2962; Bland kort gräs pa backsluttning. Smaland: Femsjö, s:n, Arvabergets sydöstra sluttning mot Arvamaden; 3 Sept 1948; S. Lundell & G. Hoglund, 5013.

The Lundell collections agree quite well with the Fries collection. Therefore, the pileipellis of Lundell should be the same as that of Fries. I also studied two additional collections labeled as *Leptonia asprella*, Ruth Gustafsson, 4 July 1938 and Lundell and Stordal 3049. In the former collection, caulocystidia were absent, the specimens were smaller and darker than the others studied, and the pigment was soluble in 3% KOH. In the latter, the apex of the stipe appeared almost tomentose and the stipitipellis at the apex was a dense entangled layer of hyphae. In my opinion, the identification of these collections is suspect.

Orton's concept of *Agaricus asprellus* indicated a fungus that may be similar to *Leptonia inocybeoides*. However, a comparison of the type description for *L. inocybeoides* by Largent (1977) and the neotype description herein presented for *Agaricus asprellus* demonstrate fungi with totally different pileipelli and spores.

Largent (1977, p. 215) discussed the relationships of *Leptonia asprella* and indicated that the name should apply to a fungus with the following macroscopic features: Pileus convex, fibrillose-squamose, livid gray except for the fuligineus-squamose pileus disc, with a translucent striate margin; Lamellae adnate, wide, and gray; Stipe 1.5 - 2.0mm wide, 25mm long, gray, bluish gray or grayish violet except for the whitish basal mycelium. The macroscopic features presented herein for *Agaricus asprellus* agree quite well with those of Kühner & Romagnesi (1953).

Literature Cited

Kühner, R. et H. Romagnesi. 1953. Flore analytique des champignons supérieurs (Agarics, Bolets, Chantrelles). Masson et C^{ie} Paris. 556p.

Largent, D. L. 1977. The Genus Leptonia on the Pacific Coast of the United States. Bibliotheca Mycologica 55. J. Cramer, Vaduz. 1977. 286p., 24 pl.

Orton, P. D. 1960. in Denis, R. W. G., P. D. Orton and F. B. Hora. New Checklist of British agarics and boleti. Supplement to Trans. Brit. Mycol. Soc. Cambridge Univ. Press, London. 225p.

MYCOTAXON

Vol. IX, No. 1, pp. 117-231 June 12, 1979

COLLYBIOID GENERA IN THE PACIFIC NORTHWEST[1]

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SUMMARY

The collybioid agarics (Agaricales, Tricholomataceae, Collybia sensu Fries) in the Pacific Northwest comprise a heterogeneous collection of fungi, which are here segregated, on the basis of both microscopic and macroscopic characters, into 11 genera (Lyophyllum, Rhodocybe, Callistosporium, Clitocybula, Baeospora, Flammulina, Strobilurus, Microcollybia, Caulorhiza, Rhodocollybia, and Collybia). Of these, Microcollybia (validated) and Caulorhiza are new. A key to the genera is provided and each genus is discussed in turn, along with a treatment of the species of each, exclusive of Lyophyllum and Collybia. In all, 34 species and subspecies are included, 4 of which are newly described and 18 proposed as new combinations.

INTRODUCTION

Species of Collybia Fr. are commonly collected and have always presented difficulties to those who would try to identify them, as they intergrade with species of other genera and frequently lack distinctive microscopical structures. Nevertheless, within the genus as it is defined by Fries, there exist numerous groups that appear to be natural and lend themselves to segregation. The practice of creating segregate genera and defining Collybia itself more narrowly began early with Karsten in 1881 (Lyophyllum) and 1891 (Flammulina) and Spegazzini in 1881 (Oudemansiella), and has been carried out largely by R. Singer from 1936 to the present. While a few of these genera has been monographed in parts of the United States (Clitocybula, 1973 and Strobilurus, 1971), the modern system in collybioid fungi has never really been applied comprehensively to a taxonomic treatment of any particular region, either in Europe or the United States. The treatments in Moser and

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[1] Portion of a dissertation submitted to the Graduate School of the University of Washington in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Gams (1967) and Metrod (1952) of european fungi, while rudimentary, remain the only ones to have employed some concepts of the modern system to a large number of the Collybia Fr. species.

The use of segregate genera seems to closely follow "natural" groupings and is the easiest, most convenient way of handling these fungi taxonomically. Anyone becoming acquainted with the majority of collybioid fungi in the Pacific Northwest would probably, on the basis of macroscopic characters alone, group the species along precisely the same lines that the segregate genera have been created. Indeed, the addition of microscopic data has served more to confirm rather than create segregate genera. The modern system has grown out of a closer acquaintance with the species, the discovery of many tropical species, and changing values in the taxonomic hierarchy growing out of an increased need for precision in classification. In the long run then, for the person who really would seek to understand these fungi, the system of segregate genera is a clarification rather than a complication of the taxonomic system.

HISTORY OF NOMENCLATURE

In 1821 Fries in Systema Mycologicum placed all of the rather small fragile, white-spored species with a convex cap and fragile stipe in the tribe Collybia of the genus Agaricus. He divided the tribe into 2 parts: Genuinae, species with rather membranous plano-convex caps, including species which would later be earmarked as collybioid; and Omphalarie, which included species more nearly marasmioid, those with depressed, plicate-rugose, or tough-pliant caps. This treatment in terms of numbers of species was quite sketchy, but nevertheless presented for the first time a step towards distinguishing the collybioid, marasmioid, and in turn the clitocyboid and tricholomoid habits. Later, in Epicrisis (1838), Fries proposed the more comprehensive taxonomic system for classification of collybioid fungi that would serve for almost one hundred years, and that remains the broad basis upon which the modern taxonomic system is built. He created the tribe Collybiae, separating the marasmioid species into another tribe and dividing Collybiae into four sections as follows:

A. Gills white to light-colored, not greyish, flesh white.
    I. Striaepedes - stipe rather thick, hollow to spongy-stuffed, sulcate to fibrillose-striate.
    II. Vestipedes - stipe thin, equal, hollow or stuffed, velvety, floccose or pruinose.
    III. Laevipedes - stipe thin, equal, hollow, glabrous (except at the base), not conspicuously striate.
B. Gills greyish or fuscous, hygrophanous.

IV. *Tephrophanae* - color fuscous or grey, allied to the tribe Tricholoma or Clitocybe, but the stipe cartilaginous.

Between 1871 and 1882, most of the species of Fries' tribe Collybia were raised to generic rank by Kummer (1871), Quelet (1872), and Karsten (1882). This change generally was one of status rather than a change in the classification system; these authors maintained the sectional divisions for the genus that Fries proposed for the tribe Collybiae.

Karsten, in addition to recognizing the genus *Collybia*, proposed two other genera: *Lyophyllum* (1881) based on a single species of *Tricholoma*, and *Flammulina* (1891), formerly *Collybia velutipes*. Both accounts remained buried in the literature, and received little recognition until the more modern system, based in part on microscopic features, began to gain acceptance. Eventually, *Flammulina* would remain monotypic and rather well defined, while *Lyophyllum* would be vastly expanded to include more tricholomoid, clitocyboid, and many collybioid species (including the Friesian section *Tephrophanae* of *Collybia* almost in its entirety). The genus *Lyophyllum*, despite its present size, remains rather poorly defined, and is held together to a large extent on the carminophilous basidia, an unwieldy feature.

At about the same time (1881), Spegazzini proposed the genus *Oudemansiella*, which Fayod in his *Prodrome d'un Histoire Naturelle* (1889) later placed in the Marasmieae, along with *Collybia* and *Marasmius*. This inclusion of a "segregate" genus in the comprehensive work marks a digression from the strict acceptance of the Friesian system.

Among the workers of the late 19th and early 20th century, there seemed a general acceptance of the genus *Collybia* sensu Fries, but there was little agreement as to the place of *Collybia* among other genera, most notably *Mycena*, *Marasmius*, *Clitocybe* and *Armillaria*.

In 1900, Patouillard proposed the "Series Collybia", to include *Mucidula*, *Mycena*, and *Collybia*. He maintained the four sections of *Collybia* that Fries had proposed while expanding the third section *Laevipedes* into two parts; without an annulus, and with an annulus (in order to include small Armillarias).

In 1932 in *Icones Selectae*, Konrad and Maublanc included among the light-gilled (Laeticolores) species of *Collybia* two more sections: *Nitellinae*, with pink verrucose spores, and *Conigenae*, small species which grow on cones of conifers and have cystidia. This seems to have been one of the first efforts towards creating a scheme of collybioid fungi which seeks more actively to include microscopic characters. The impetus to include microscopic as well as macroscopic characters as the basis for differentiating genera and species, and the delimitation of new genera on the basis of a distinct, conspicuous set of microscopic features was beginning to grow rapidly.

Singer in 1936 proposed a most comprehensive system which covered all of the Agaricales and tended not only to delimit the Friesian genera more precisely by the creation and grouping of segregate genera, but also to clarify partially the relation of genera and microscopic features to each other by the creation of families within the order Agaricales. Part of the contribution of this early work and the large number that were to follow, was the collection and organization of a large store of information on microscopic characters that once organized could be published in book form and made available to a larger number of people. Because Singer was the most forceful and widely published agaricologist of this era, the modern system is frequently referred to as the Singerian system. In his treatment of *Collybia*, Singer began (1936) by creating the family Tricholomataceae into which he put *Collybia*, as well as the segregate collybioid genera of *Lyophyllum*, *Rhodocybe*, *Crinipellis*, *Myxocollybia* (synonymous with *Flammulina*), *Oudemansiella*, *Xerula*, and *Fayodia*. This system was elaborated further in the *Agaricales in Modern Taxonomy* (1942, 1962) by the elaboration of Tribes within the Tricholomataceae. For *Collybia* and many of its segregates, he created the tribe *Collybiae* (most of the other tribes were based on "Friesian genera", except the tribes Lyophyllae and Leucopaxillae). Also, Singer expanded to eight the sections of *Collybia* itself, four of which are based on tropical species. These sections are as follows:

Section I. *Stripedes* - stipe rather thick, more or less striate or sulcate, spore print cream pink.
    Stirps *Maculata* - pseudorhiza present or absent, context of pileus thick, cuticle rather dry.
    Stirps *Butyracea* - lacking a pseudorhiza, pileus thin, pileus lubricous.
    Stirps *Fusipes* - perennial pseudorhiza, growing at the base of trees.
Section II. *Dictyoplocae* - stipe somewhat sulcate-striate, almost smooth, glabrous; spore print creamy white when fresh, pinkish cream in the herbarium; pileus white to violet, lamellae slightly to strongly venose anatomosing.
Section III. *Iocephalae* - Carpophores with a purplish pigment, becoming pink in acids, violet in alkali, lamellae not anastomosing.
Section IV. *Laevipedes* - stipe smooth, glabrous to whitish pruinose, or with a brownish

strigosity at the base, spore print white, lamellae not anastomosing; epicutis strongly reduced ("partly broad, not rarely branching, but not diverticulate, not radially arranged").

Section V. Vestipedes - stipe neither glabrous or long - sulcate, partly or entirely villous, pruniate, tomentose or strigose; spore print white to pale flesh colored; epicutis well developed, narrowly filamentose, not diverticulate.

Section VI. Subfumosae - epicutis differentiated, with a distinctly developed rameales structure, nodulose-coraloid to diverticulate or with repeated thin side branches.

Section VII. Cystidiatae - species with very conspicuous cheilocystidia, stipe glabrous to subglabrous, often uneven, epicutis lacking rameales structures.

Section VIII. Collybia (Cirrhatae) - stipe not sulcate, finely pruinate pubescent, or with conidiophores, pileus white or whitish, striate on the margin, at least in moist conditions, cap very thin or membraneous; stipe racemose and/or arising from a sclerotium, more rarely neither racemose nor arising from a sclerotium; cheilocystidia none, or very inconspicuous, frequently on decaying basidiomycetes.

In addition, between the first proposal of the modern system by Singer in 1936 to the publishing of the 2nd edition of Agaricales in Modern Taxonomy (1962), seven other segregate genera were published: Baeospora Singer (1938), Pseudohiatula (Singer) Singer (1938), Lactocollybia Singer (1939), Callistosporium Singer (1944), Microcollybia Metrod nom. nudum (1952), Clitocybula (Singer) Metrod (1952), and Strobilurus Singer (1962).

Kuhner and Romagnesi (1953) in Flore Analytique des Champignones Superieurs remained more conservative than did Singer as regards the creation of new genera and the acceptance of those segregate genera already published; however, their treatment of Collybia itself in the key is quite distinct from the "Friesian sections" and from those of Singer, which rely heavily on the use of macroscopic features proposed by Fries. The key to Collybia is divided into four "sections". The characteristics of these groups are as follows:

Section A - species with a more or less thick stipe (2-4 mm or more), never filiform or branched, always without sclerotia, not found on cones or decaying mushrooms, never really violaceous, the pileal surface neither viscous nor hymeniform, spores non-amyloid (e.g. *C. acervata*, *C. butyracea*, *C. maculata*).

Section B - cap covered with streaks of brownish fibrils, grey or blackish shiny, more or less rimose and splitting radially in bands of fibrils of these colors, separating towards the margin and lighter, sometimes squamulose, spores 5-7 x 4-5 um or larger (e.g. *C. platyphylla*, *C. lacerata*, *C. lenta*).

Section C - stipe thin (1-2 mm), pruinose or ramified, gills frequently serrate, cap neither streaked or rimose, the epicutis not gelatinized or hymeniform, spores very small (3-5 x 1-3 um) or amyloid, sometimes found on cones or decaying basidiomycetes, with or without a sclerotium (e.g. *C. fuliginata*, *C. tuberosa*, *C. conigena*).

Section D - cap neither streaked or rimose, but either viscous or cellular-hymeniform, generally with striking pleurocystidia, spores non-amyloid. (*C. tenacella*, *C. mucida*, *C. longipes*).

GENERIC CONSIDERATIONS

The term "collybioid" is synonomous with the tribe Collybia of the genus *Agaricus* created by Fries, and in defining the tribe he used the following characteristics: cap small, convex, becoming plane, margin inrolled at first, gills not decurrent, stipe cartilaginous, and spores white. Although this definition applies to some of the fungi that Fries himself put in *Collybia*, it generally lacks the precision and scope to describe the majority of collybioid fungi. Consequently the definition of collybioid has been expanded on the basis of the Friesian species to include the following broader lines: cap hemispheric, convex or plane, depressed or umbonate, generally glabrous, sometimes pubescent to fibrillose; gills almost free or broadly adnate to subdecurrent, spores white to yellow or salmon pink in deposit; stipe more or less cartilaginous, generally glabrous, occasionally sulcate, striate, pubescent, or tomentose; spores smooth or roughened, amyloid or not, with or without cystidia, pileal surface hymeniform, filamentous, or subgelatinized, rarely with a subcellular hypoderm, clamps lacking or present. From this definition, the heterogeneous character of the genus *Collybia* Fries is readily apparent.

Generally collybioid fungi have convex to hemisphaeric caps when young, the margin is strongly inrolled and as the carpophores develop, the margin is raised and becomes unrolled giving the cap a flat or "plane" appearance. This condition is in contrast to the mycenoid condition in which the cap is conic at first and the margin straight; later in development, the margin which was adpressed to the stipe becomes raised and a rather pointed or bell-shaped aspect is maintained. The center of the mycenoid cap never really becomes flat at maturity.

Many collybias tend to be somewhat centrally depressed at maturity, especially when the margin becomes revolute and raised above the point of gill attachment, but this condition does not approach the umbilicate character so frequently found in *Clitocybe* in which the carpophores are strongly depressed even when young. Furthermore, the gills are never truly decurrent as they are in *Clitocybe*. Some collybioids have gills that are emarginate and frequently uncinate as well; a few are broadly adnate and if the cap margin is raised above the point of attachment of the gills to the stipe, these sometimes appear subdecurrent. There exist, however, a few species whose gills are shallowly emarginate-ventricose and strongly uncinate, where even close scrutiny does not further clarify the distinction between adnate and subdecurrent, or between the genera *Collybia* and *Clitocybe* sensu Fries. The distinction between these two genera must in such circumstances remain largely unresolved if there are not attendant differences in microscopic features. Given this difficulty, it is fortunate that among the smaller species of *Clitocybe* in this area, all but a very few are marked by strongly decurrent gills and centrally depressed caps.

Tricholoma differs from collybioid fungi, except for the genus *Rhodocollybia*, by its much large size and the fibrous nature of its cap and stipe. In *Rhodocollybia* the presence of a colored spore print, staining characters, distinctive shape and character of the stipe, and dextrinoid spores serve to delineate it from *Tricholoma*.

Of all the genera, separation of *Marasmius* from *Collybia* has been by far the most difficult. There is a common ground between the two genera where both macroscopic and microscopic characters intergrade somewhat, and the classical distinction of *Marasmius* on the basis of pliant-tough, reviving flesh, while useful, is neither consistent nor manageable enough to serve as a unique generic feature. Fortunately, the species of *Marasmius* in the Pacific Northwest and probably in any coniferous area, are relatively few and seem to intergrade less than those species in areas where hardwoods predominate. In this treatment, I have excluded from *Collybia* Fr. any species with the following characters: an insititious stipe; a stipe which is very slender, wiry or setose; one that is accompanied by black rhizomorphs; distant or intervenose gills; bilateral lamellar trama; a dextrinoid pileal context; long, thick-walled, setoid pileocystidia; fusoid spores; a pileal surface composed of diverticulate hyphae or broom cells; and a pileal surface which is hymeniform if the spores are nonamyloid and the hyphae clamped.

TAXONOMIC CHARACTERS

SIZE - Collybioid fungi range from very small mushrooms of delicate stature (less than 0.5 cm) such as those of the segregate genus *Microcollybia* (including the former *Collybia racemosa* and *Collybia tuberosa*) to large mushrooms (greater than 7 cm) such as some species of *Rhodocollybia*, which are large relative even to many other agaric genera. Nevertheless, the adjective "collybioid" encompasses the majority of species in this treatment, and by definition means that the cap size is about that of a "small coin". The stipe and lamellar size are congruent with the rather small size of the cap, and in general, these species are a little larger and somewhat tougher than most Mycenas.

CAP CHARACTERISTICS - Strongly umbonate or umbilicate caps do not characterize *Collybia* sensu Fries, although a few of the species included here are umbonate or umbilicate enough to be distinguished partially on this basis.

The cap is generally pale-colored to tan, or some shade of brown, and hygrophanous. Some *Rhodocollybia* species develop vinaceous spots with age or bruising on the gills and stipe. Species in the genus *Lyophyllum* generally have a grey to fuscous tone on the cap and often stain or bruise brown, bluish-black, or black. *Callistosporium* species in this area are olivaceous and turn vinaceous black or deep burgundy on drying. *Baeospora myriodophylla* has when moist a brown cap with a decided violaceous tinge, and conspicuous purple gills.

The great majority of collybias have glabrous caps which in the fresh condition may be dry to glassy-lubricous, becoming dull-matte in drying. Occasionally under very moist conditions they appear subviscid. Some of the segregate genera are characterized by surface features of the cap: *Clitocybula* species frequently are radiate-striate with blackish fibrils. *Flammulina* is viscid, and *Strobilurus* appears pubescent due to the presence of abundant pileocystidia. A few species are markedly translucent-striate, but this condition certainly does not exemplify the genus as it does in *Mycena*.

The majority of Collybias are rather membranous, and somewhat fragile; yet, in species of *Microcollybia*, *Strobilurus*, and *Baeospora* the flesh, though thin, may be quite firm, tough and pliant, but generally not reviving easily as in the genus *Marasmius*. *Rhodocollybia* has a thick (generally at least 1 cm), rather soft pileal context which tapers towards the margin and usually is so thin there that species of this genus sometimes have a frayed, ragged cap margin at maturity.

LAMELLAR CHARACTERISTICS - As the color of the spores is white, the gill color generally also is whitish; frequently the gills are off-white with yellowish to brownish tones. Considering mature carpophores, truly white gills are rather uncommon in the large species, although they seem to predominate in small species (*Strobilurus* and *Microcollybia*). Species of *Rhodocybe* have a pale pink to salmon brown spore print and correspondingly the gills have a characteristic "pinkish" blush at maturity. *Rhodocollybia* has yellowish gills at maturity and the spore prints of this genus range from pale orange to pink to pale salmon. Gills of the genus *Callistosporium*, which in the fresh condition are a bright yellow to yellow-olivaceous, turn deep vinaceous due to the presence of a pigment that colors on drying. Gills of other collybioids invariably are yellow in the herbarium, becoming darker with age.

The lamellae of some species of collybioids are narrowly adnexed, appearing almost free; others are emarginate and frequently uncinate as well; a few are broadly adnate.

Generally the gills are thin and rather soft, rarely thick and firm-waxy. Gills which are close or crowded seem more common than those which are subdistant or distant. The gills are never anastomosing, and an intervenose condition is very rare. In the genus *Rhodocollybia*, the lamellar edge is often serrate, even in young specimens, and at maturity eroded or frayed. This genus is also marked by ferruginous spots on the gills. *Lyophyllum* species of the section *Nigrescentes* stain blackish, rather rapidly, on the gills.

STIPE CHARACTERISTICS - The stipe of collybioid fungi is characterized as being more or less cartilaginous and fragile, equal, glabrous, and tubular. Many collybioid species differ somewhat from this "formula", but generally do not differ widely. *Strobilurus* has a chrome yellow to pale tawny stipe which is strongly but finely pubescent above and long tawny-tomentose below the substratum. *Flammulina* has a deep warm brown stipe which is conspicuously and strongly velvety. Species of *Microcollybia*, *Rhodocybe* and some of the smaller *Lyophyllums* frequently have stipes with an undulate or wavy surface. Large, stout, and often solid and fibrous stipes characterize some members of the genera *Rhodocollybia* and *Lyophyllum*. In *Rhodocollybia* the stipe also is generally enlarged towards the base, then tapered abruptly into a short root-like "tail". It is also strongly striate-grooved for most of its length, and generally stained ferruginous towards the base where it emerges from the "woody" substratum. *Microcollybia*, for the most part, is characterized by the presence of a conspicuous sclerotium (yellow, reddish brown, or black) from which the stipe arises. One species of this genus (*Microcollybia racemosa*) has certainly the most unusual of stipes: short, side branches arising at right angles from the stipe produce globose slimeheads of hyaline condia. *Caulorhiza* has a very long tapering "root" or pseudorrhiza which may be two or three times as long as the above ground portion, and the stipe is frequently clothed with a heavy powdery-pubescence.

ODOR and TASTE - Most collybioids lack strong and distinctive odors. However, as collybioids lack many distinguishing traits in general, an odor, even if faint, often can with training be of some help in the rapid and tenative identification of species. In this respect, I have tried to include whatever information I obtained regarding odor and taste, but with the qualifications that such characters are frequently rather variable and such information is highly individualistic, capable of broad interpretation, and consequently can rarely serve as a reliable basis for the taxonomy of these fungi. Nevertheless, the following species can be secondarily characterized by the presence of a strong odor which is constant from collection to collection: *Collybia polyphylla* smells of a mixture of garlic and radishes, the taste is very unpleasant and strong of garlic; *Rhodocollybia oregonensis* has an odor of almond extract or benzaldehyde, no taste accompanying the odor; *Rhodocybe nitellina* and many Lyophyllums smell strongly farinaceous.

MACROCHEMICAL SPOT TESTS - A great many collybioid fungi react with alpha-napthol,guaiacol, phenol, and phenol-aniline. They generally remain unreactive with formol, sulfoformol, aniline, ferric sulfate, tincture of guaiac, and PDAB (other than a faint pink reaction on the gills). Few collybioid genera are characterized or easily set apart from other genera on the basis of these spot tests, which seem most valuable in distinguishing one species of a genus from another of the same genus, especially as regards rapid and tentative identification of fresh specimens. Of the genera in this treatment, three (*Microcollybia*, *Strobilurus* and *Callistosporium*) are distinctive by their absence of reactivity with all or most of the macrochemical reagents. Each of these three genera however is distinctive, both in macroscopic and microscopic aspects, from other genera, and consequently their identification is not problematic. The added feature of non-reactivity to these reagents helps to support the segregation of these genera from *Collybia* sensu Fries, but still they are characterized most easily by other, more conspicuous traits. *Lyophyllum*, a genus which sometimes is easily recognized, but which includes so many varied species that positive identification is dependent on the troublesome carminophilous test, may be one collybioid genus that can best be identified through macrochemical spot tests, at least as a preliminary to the carminophilous procedure. Members of *Lyophyllum* react slowly with sulfoformol to produce a light mint green to olive color on the edges of the gills and flesh; they turn a solution of PDAB abruptly bright blue-green, and frequently react with aniline to give a lemon-yellow or orange color. Reactivity to the other macrochemical reagents is variable, but on the whole, species of Lyophyllum tend to be rather reactive. The combination of reactivity to sulfoformol and PDAB apparently does not exist in any other collybioid genus, or many other agaric genera for that matter, and may consequently be a rapid and tentative means of identifying the genus without the carminophilous test. These two reagents should be applied to the study of other noncollybioid agaric genera to determine whether or not the combination sulfoformol-PDAB really is indicative of carminophilous basidia or is more widely applicable.

HABITAT - Most collybioids are terrestrial and are found scattered to gregarious in dense woods during the fall season. Relatively few are lignicolous, grow in a caespitose manner, or are found in open disturbed areas. Because the majority of forests in this area are predominantly coniferous, most of the collybioid species in this study are likewise associated with coniferous conditions. Members of the genera Flammulina, Baeospora, and Strobilurus may be considered lignicolous, and the latter two are often associated with cones. Rhodocollybia is often found in much decyaed wood which might better be classified as "humus". Microcollybia is associated with the old, tarry, hardened remains of decayed agarics.

SPORES - Spores of most collybioid fungi are quite small, less than 10 µm, thin-walled, smooth, nonamyloid, hyaline, and ovate to ellipsoid. Strobilurus, Baeospora, Microcollybia, and Clitocybula have minute spores that rarely exceed 4-5 µm in length; some species of Rhodocollybia have rather long spores, reaching occasionally 10 um, but no collybioid genus is characterized by really large spores. No pip-shaped or boletoid spores occur in collybioid fungi. Spore shapes range from globose to narrowly ellipsoid, and generally the spores are rather thin-walled but with the wall thick enough not to collapse in a crush mount. The genus Rhodocybe is characterized by having ornamented spores, usually slightly angular in end view and longitundinally wrinkled in side view. Rhodocybe olympiana has coarsely echinulate spores. Occasionally the spores of Rhodocybe are so weakly ornamented that this character is overlooked in the microscopic examination of a collection. Lyophyllum ambustum, according to european workers, has verrucose spores.

While most collybioid species have spore prints that are white in the fresh condition, the print frequently becomes yellow in the herbarium or with age and drying. Members of Rhodocollybia are characterized by a pale yellow to peach colored spore print in the fresh condition, and Rhodocybe has a pale pink to dark salmon pink print. Spores of Baeospora and Clitocybula are amyloid; Rhodocollybia has a dextrinoid inner wall (endosporium) which is thickened and frequently retracts from the apicular end of the spore giving a truncated appearance. This condition is generally present only in a percentage of the spores. Sometimes the vast majority of the spores will be thick-walled and dextrinoid, while in other collections only a few spores in any one crush mount will show these characteristics. In the genus *Callistosporium*, the spores are hyaline in the fresh condition, but become vinaceous on drying. This peculiar feature is due to the presence of a pigment which changes from hyaline to vinaceous under certain circumstances (in alkali or drying); the pigment is present throughout the carpophore, and consequently, a herbarium specimen will be entirely burgundy-colored.

BASIDIA - The size of basidia in collybioids, as in other agaric genera, seems to vary with the spore size; the larger the spore, the larger the basidia and vice versa. Few species have basidia shorter than 15 µm or longer than 35 µm; the width varies usually from 4 to 8 µm. As mentioned above, *Callistosporium* and *Lyophyllum* have basidia with densely granular cytoplasm, the former with a pigment that turns vinaceous on drying or in KOH, and the latter with granules that stain reddish black with mordant and acetocarmine. Rarely are the basidioles or basidia distinctive enough in size or shape to be of taxonomic importance. There are no exclusively two-spored species in this treatment; however, a few species occur in the genera *Collybia*, *Rhodocybe*, *Rhodocollybia*, and *Lyophyllum* which appear regularly to have carpophores with both two and four-spored basidia.

CHEILOCYSTIDIA and PLEUROCYSTIDIA - Most collybioid fungi lack distinctive cheilocystidia, but some species have "cystidioles" either scattered or abundant on the gill edge. These are clavate to filamentous and characteristically contorted, sparsely branched, coarsely knobby, hyaline, thin-walled, non-encrusted, and rarely exceed the height of the basidia. They are inconspicuous and best observed in crush mounts of the gill edge. The abundance of these "cystiodioles", as well as their degree of branching, contortion, and knobbiness seems to vary widely from collection to collection in some species; in other species, however, these traits appear to be quite constant.

The genera *Strobilurus*, *Baeospora*, *Flammulina*, *Caulorhiza*, and *Rhodocybe* section *Rhodocybe* are characterized by abundant, well differentiated cheilocystidia of a given shape and size. Except for the species of *Strobilurus*, these cystidia are thin-walled, non-encrusted, generally clavate and hyaline. The cystidia of *Rhodocybe aureicystidiata* nom. prov. are conspicuously yellow colored and often arise from like-colored conducting elements in the gill trama. Species with well developed cheilocystida frequently have pleurocystidia as well, and of the same shape and size as the cheilocystidia. *Strobilurus* has cystidia on the gill edge, gill face, cap surface, and stipe. These are generally the same shape and size, although the stipe and cap cystidia tend to be slightly longer and narrower than those found on the gill. *Baeospora* produces an abundance of cheilocystidia which are quite short, broad, and thin-walled, and although the gill edge is entirely sterile and composed only of cheilocystidia, the gill face itself has relatively few pleurocystidia, these being most abundant near the gill edge.

PILEAL SURFACES - The majority of collybioid fungi have a cap which is covered by a thin cutis composed of narrow, radially oriented, non-encursted, and often agglutinated hyphae. This cutis normally intergrades with the contextual hyphae in size and compactness, and occasionally intergrades also in encrustation and orientation. There are relatively few species which present a narrow surface zone conspicuously different from the tissues immediately underlying it. In addition, some of the species in various of the genera form innate "dermatopilocystidia" as the upturned, rounded and inflated ends of the surface hyphae. These "cystidia" frequently are extremely variable in size, shape, and abundance, and may be very inconspicuous or even absent from some collections of the species in which they are often found.

Some members of Rhodocollybia and a few species in other genera have the upper cutis layer gelatinized; the gelatinization can vary from a slight agglutination of the surface hyphae to a more rarely encountered condition in which the entire depth of the cutis is affected. Collybia dryophila and its affiliates have surface layers composed of rather larger diameter hyphae which are more or less interwoven and not appreciably different from the context. Such surfaces have been termed "undifferentiated", and are distinct from the more common situation in which a cutis of narrow parallel, radial, hyphae overlies larger contextual hyphae. Flammulina velutipes is characterized by a viscid layer of partially gelatinized, upright hairs. And a "hymeniform" layer of inflated-clavate, pedicellate cells interspersed with conspicuous pilocystidia is a prominent feature of the genus Strobilurus. The genus Caulorhiza presents a more complex surface: a cutis layer of radial hyphae bearing scattered dermatopilocystidia, subtended by a subcellular layer, which in turn overlies the radial layers of the context.

CLAMPS - Clamps are present in the great majority of collybioid fungi. They are found easily in the cap context and gill trama since they frequently are rather large. Nevertheless, members of Strobilurus, Callistosporium, and a few species of Rhodocybe are characterized by the lack of clamps.

MATERIALS AND METHODS

Macroscopic descriptions were drawn from notes made on fresh materials, unless otherwise noted. Colors in the Kornerup and Wanscher (Methuen) Color Handbook are numbers and are cited in parentheses; those of Ridgeway are enclosed in quotation marks.

Microscopic features were generally examined using dried material. The tissue was rehydrated by first wetting with 95% ethyl alcohol, then mounting in Melzer's or 3% KOH, to which a small drop of phloxine and congo red had been added. Radial and tangential sections of the cap and cross and longitudinal sections of the stipe were generally made with a freezing microtome or occasionally by hand using elder pith. Drawings of microscopic features were made from crush mounts with the aid of a Zeiss camera lucida and a 20x eyepiece. The habit drawings were made in pencil from kodachrome slides, unless otherwise indicated.

The macrochemical reactions were done using white china spot plates with multiple shallow wells, each well containing a small quantity of the tissue being tested and two drops of one of the reagents. Due to the small and fragile nature of most collybioid fungi, portions of the entire cap (including surface, context, and gills) were tested rather than using only the pileal context. A small pie-shaped piece of fresh cap was cut into strips, and these transferred to the wells of the spot plate. The reactions were read after 20 minutes, and recorded if positive, as a series of "+"'s, relative to the strength of the reaction (depth of color). Since the reagents generally produce only one color change, the species descriptions indicate only whether a test was positive, not the actual color change; however, any variation from the normal color is indicated in the species description. The positive reaction for each of the macrochemical tests, and the composition and procedure used in making the reagents (given in parentheses) is as follows:

Aniline: pale lemon yellow to light orange or apricot.
(1:1 (v/v mixture of aniline oil and water.)
Ferric sulfate: pale greyish-green to medium olive.
(A 10% solution was made by dissolving 24 gm ferric sulfate in 240 ml water.)
Formol: pale yellow or orange.
(40% aqueous solution.)
Guaiacol: pinkish-red to dark reddish black.
(Dissolve liquid guaiacol in water to saturation.)
Alpha-Napthol: purple to purple-black.
(10 gm alpha-napthol dissolved in 70 ml of 95% ethanol, solution brought up to 200 ml volume with water.)
PDAB (p-dimethylamino-benzaldehyde), 2%: solution itself turns rapidly brilliant blue-green, rarely raspberry red. A faint pink-purple reaction of the gills was taken as a negative reaction.
(6.0 gm PDAB dissolved in 229 ml 95% ethanol, 71 ml conc. HCl added.)
Phenol, 2%: red to dark reddish black.
(4.8 gm carbolic acid dissolved in water and

the volume brought to 240 ml.)

Phenol-aniline: ferruginous to dark reddish umber. (2 drops each of the aniline water and phenol solutions.)

Sulfoformol: pale yellow or a pale mint green on the edges of the material tested. (2 drops 40% aquaeous solution of formol mixed with 2 drops 50% sulfuric acid.)

Tincture of guaiac: light blue to dark bluish-green. (Dissolve finely powdered gum guaiac in 95% ethanol to saturation, then filter.)

KEY TO COLLYBIOID GENERA

1. Basidia carminophilous, carpophores generally fuscous in some part and often staining blackish, reacting faintly with sulfoformol to give a mint green color and strongly and rapidly with PDAB to give a bright blue-green color to the solution.. Lyophyllum (p. 132)

1. Basidia without carminophilous granules, carpophores generally some shade of brown and never staining blackish, reacting neither with sulfoformol nor PDAB in the above manner................................ 2.

    2. Spores angular in polar view only, slightly roughened, spore print pink to dark salmon in heavy deposit................. Rhodocybe (p. 134)

    2. Spore outline smooth both in side and polar views, not roughened, spore print white to cream, if pinkish in heavy deposit, then at least a portion of the spores with a dextrinoid endosporium.. 3.

3. Spores heavily granular, becoming vinaceous in KOH, carpophores olivaceous in the fresh condition, becoming deep vinaceous in drying.. Callistosporium (p. 147)

3. Spores sometimes guttate, not heavily granular, not becoming vinaceous in KOH, neither olivacous in the fresh condition nor changing to vinaceous black in drying.. 4.

    4. Spores amyloid, and either spores minute (5 µm or less) and globose to short-ovate or stipe radicating.................................... 5.

    4. Spores hyaline to reddish brown (dextrinoid) in Melzer's, spores generally at least 5 µm or ovate to ellipsoidal......................... 7.

5. Stipe radicating, under redwoods.. Caulorhiza (p. 154)

5. Stipe not radicating, carpophores not found under redwoods.. 6.

    6. Caps fuscous and radially streaked with blackish fibrills, generally 3 cm or more in diameter or carpophores densely caespitose, without cheilocystidia.................. Clitocybula (p. 157)

    6. Caps tan to violaceous, never fuscous, generally

less than 3 cm, not radially streaked with blackish fibrils nor densely caespitose, gill edge heteromorphous with short clavate-inflated cheilocystidia...... Baeospora (p. 162)

7. Pileus viscid, composed of brownish upright, partially gelatinized hairs, stipe velvety with brownish hairs...................... Flammulina (p. 170)
7. Pileus neither viscid nor the stipe velvety with brownish hairs.................................. 8.
   8. Pileal surface hymeniform, composed of a palisade of inflated, pedicellate cells, pubescent with conspicuous cystidia on all surfaces, the stipe rooting, tawny, and long-tomentose in the lower half, growing generally on cones, more rarely on wood............ Strobilurus (p. 174)
   8. Pileal surface undifferentiated or composed of a cutis but never hymeniform, cystidia absent or barely differentiated, the stipe neither rooting nor tawny and long-tomentose in the lower half, terrestrial or occurring on much decayed wood or mushrooms..................... 9.
9. Species growing on the tarry remains of decayed mushrooms, caps minute, generally less than 1 cm, white to fuscous, frequently with a conspicuous sclerotium (orange, brown, or black)............. .... Microcollybia (p. 187)
9. Species terrestrial or occurring on much decayed wood, caps medium-sized to large, generally at least 2 cm, some shade of tan or brown, without a sclerotium...10.
   10. Spore print cream to pink in fresh heavy deposit, at least a portion of the spores with a dextrinoid endosporium, large species, cap diameter generally 5 cm and often more....... .... Rhodocollybia (p. 198)
   10. Spore print white in fresh heavy deposit, spores lacking a dextrinoid endosporium, medium-sized species, cap diameter generally less than 5 cm............... Collybia (p. 228)

LYOPHYLLUM Karst. Acta Fl. Faun. Fenn. 2:3. 1881, em. Singer. Agar. Mod. Tax. pg. 209-213. 1962.

Synonyms: Clitocybe pro parte Kummer. Führ. Pilzk. p. 26. 1871.
Collybia pro parte Kummer. Führ. Pilzk. p. 26. 1881.
Tricholoma pro parte (Fr.) Quél. Champ. Jura. Vosges. p. 76. 1872-3.
Hemicollybia G. Beck. 1922. fide Singer op. cit.

Type species: Lyophyllum leucophaeatum Karst.

PILEUS-collybioid, tricholomoid, or clitocyboid, flesh membranous to thick (10 mm) and generally concolorous with the cap, umbonate to centrally depressed, not umbilicate, margin enrolled at first and often straight at maturity, surface generally uniform, occasionally undulate, and glabrous to slightly fibrilar or pruinose-powdery, often moist-striate in the smaller species, generally dull-colored or fuscous, rarely white, hygrophanous and usually changing to a much lighter color, staining or not, smell and taste often distinctive and generally farinaceous in one of its forms (green bean, green corn, floury, linoleum, rancid, and fishy-cucumber odors).

The fuscous colors of cap, gills and stipe which are so distinct for this genus are lost in drying with few exceptions. The dried carpophores vary from bone white to fuscous, but are most often some shade of fulvous, buff, or medium brown.

LAMELLAE pallid to blackish, frequently staining bluish-black or black, edges even and usually concolorous, shape variable, subdecurrent to almost free, crowded to subdistant, and generally thin, never really thick.

STIPE pallid to blackish and generally concolorous with either cap or gills, rarely strikingly different from these, often equal but sometimes expanded at the base and somewhat club shaped although never with an emarginate bulb, many of species in the section Tephrophana having undulate stipes, and the base flexuous, species in the section Difformia caespitose and as such frequently connate and expanded at the base, the surface is usually glabrous and then sometimes powdery-pruinose at the apex or finely appressed fibrillar-streaked, not glabrescent; solid, stuffed or hollow; with or without a rind, sometimes staining readily black or darkening slowly with handling or age.

BASIDIA conspicuously granular and the granules stain a dark reddish-black in acetocarmine. The size of the basidia vary widely, 15-40 µm x 5-10 µm, the spores globose, ovate, cylindrical, or ellipsoidal, and rarely exceed 10 µm in length or 6 µm in diameter. They are smooth, angular, or echinulate, and inamyloid, the TRAMA parallel to subparallel with a mediostatum of large cells which intergrades with narrower hyphae next to the subhymenium, and if this feature is well developed the gill trama looks almost divergent in transverse section; tramal hyphae frequently slightly dextrinoid, quite large (3-25 µm, average about 7-8 µm), and abundantly provided with conspicuous large clamps; CHEILOCYSTIDIA generally not present or inconspicuous and rarely exceeding the height of the basidioles; PILEAL SURFACE frequently undifferentiated from the context, or composed of a cutis of varying thickness of narrow, radial, repent, tubular hyphae; occasionally both surface types becoming subgelatinized; contextual hyphae much like the hyphae found in the lamellar trama and relatively large and clamped, brownish pigments sometimes present and encrusting the pileal surface hyphae, rarely giving the cuticular hyphae a thick and patterned encrustation; in the black staining members of the section *Lyophyllum* the basidia usually irregularily coated with an extra-cellular pigment which appears sticky and takes on a dark dingy dextrinoid reaction in Melzer's solution.

HABITAT - The carpophores are caespitose to solitary and found most frequently on soil or mulch. They seem to be rare on wood but a group of species is characteristically found on charred wood or ground. One species, *L. palustre* (Peck) Singer, is encountered only in association with *Sphagnum*, and is apparently the only possible exception to the rule of saprophytism in the genus.

MACROCHEMICAL REACTION - The caps give a faint but distinct green reaction in sulfoformol, and a solution of PDAB turns rapidly bright blue-green when in contact with any part of the carpophore. This combination of reactions seems to be specific for *Lyophyllum*. In addition, many species of this genus react with aniline to give a yellow or apricot color, a reaction which is distinct and found in few of the other collybioid species studied. There is variability in the reactions with alpha-napthol, guaiacol, tincture of guaiac, phenol, and phenol-aniline and as more data is accumulated these reactions may prove helpful in delimiting certain species.

The carminophilous basidia, the reaction of the flesh with PDAB and sulfoformol, and the fuscous shades of cap, gills and stipe seem to delimit the genus from closely related genera, especially *Collybia* and *Clitocybe*. In addition, the bruising reactions, extracellular pigment on the basidia, large hyphae of trama and context, weak dextrinoid character of the trama, farinaceous odors, and reactions with aniline tend to hold the genus together, although somewhat loosely.

RHODOCYBE R. Maire sensu Singer emend. Bull. Soc. Mycol. Fr. 40:298. 1925.

Synonyms: *Clitopilopsis* Maire, Publ. Inst. Bot. Barcelone 3(4):82. 1937.
Hirneola Velen., Nov. Myc., p. 73. 1939. non Fr. (1849).
Pluteospora Maire, Bull. Soc. Mycol. Fr. 50:xxii. 1935.

Type species: *Rhodocybe caelata* (Fr.) R. Maire

HABIT variable, collybioid, mycenoid, omphalioid, clitocyboid, tricholomoid, or pleurotoid; *pileus* pigmented or not.

LAMELLAE adnexed, adnate, or decurrent, sometimes rounded to sinuate, sometimes initially ascending, generally rather thin, often close or crowded, edges normally even and concolorous, pallid to medium colored, generally with a pinkish tinge; spore print pink to salmon grey, very pale to the color of a Rhodophyllus print or somewhat greyer.

STIPE variable, following the habit, attachment generally central.

SPORES hyaline to pale stramineous in transmitted light, rough, warty or spinose, some almost smooth, sometimes rounded-angular to rather strongly angular in polar view (a minority of spores then also somewhat angular in profile), generally ovate to ellipsoidal, nonamyloid; BASIDIA four-spored or more rarely two-spored, without carminophilous granulation; CHEILOCYSTIDIA differentiated or absent, pleurocystidia differentiated or absent, sometimes arising from the gill trama and continuous or not with a system of conducting elements, not gleocystidioid nor macrocystidioid, not laticiferous, although often strikingly colored; GILL TRAMA strictly regular, consisting of long filamentous, parallel or sub-parallel hyphae; PILEAL SURFACE consisting of filamentous hyphae forming a cutis, these hyphae generally not at all interwoven but instead radially arranged; trama and pileal context with or without clamps; all tissues nonamyloid.

HABITAT: Terrestrial or on wood, solitary to caespitose.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap are generally quite reactive and most collections are positive to alpha-napthol, guaiacol, tincture of guaiac, phenol, phenol-aniline, and ferric sulfate. In addition, there are variable or weak reactions with aniline, formol, and sulfoformol.

Maire (1925) defines Rhodocybe very narrowly and includes only those species having nonencursted, refractive pleurocystidia, roughened spores which are pink in deposit and not angular in any view; with a clitocyboid habit, and with definitely decurrent gills (no mention was made of clamps). Singer has emended the genus to include a wide variety of habits, and more variability in spore shape and ornamentation, as well as the absence of cystidia or their type, if present. He continues to emphasize the presence of pink spores, which are roughened, although never truly angular, and adds the absence of clamps as a distinguishing feature. Unfortunately, in one of his largest sections (Nitellinae) in the genus, he includes as the type, a species with clamps. Therefore, I have included in Rhodocybe species with clamps and have followed Singer's system rather closely while emending it to include those species that are clamped. At the same time, such an emendation draws the genus very close to Lepista, which is usually distinguished from *Rhodocybe* by the presence of clamps, the absence of cystidia of any kind, and by spores which are always uninucleate. Since *Lepista* rarely approaches a collybioid habit and is so often large and fleshy, the distinction between the two genera can often be made on the macroscopic level for the size of species that are included here in *Rhodocybe*.

Key to the Sections of *Rhodocybe*

1. Species without any cystidia whatsoever, pileal flesh some shade of orange or fulvous, at least at maturity .... 2.
    2. Pileus at first "hair brown" or "mummy brown", changing to "ochraceous-tawny" and "cinnamon-brown", spores ovate to subglobose, echinuate... .... Section *Echinosporae* (p. 136)
    2. Pileus unchanging, some shade of rusty orange, fulvous, deep cinnamon, brownish yellow, or tan; spores generally ellipsoid, occasionally ovate to subglobose, coarsely roughened to subangular especially in end view.......................... .... Section *Nitellinae* (p. 138)
1. Species with pleurocystidia, often very striking and colored (rarely absent), pileus white or some shade of grey or fuliginous-fuscous....................... .... Section *Rhodocybe* (p. 145)

Section *Echinosporae* Lennox nom. nov.

Habitus collybioideus, pileus primo fuscus vel atrofuscus, in maturitate laete fulvoferrugineus, quasi "ochraceous tawny" vel "cinnamon brown"; cystidia desunt; sporae ovatae vel subglobosae, echinulatae; in reliquiis putrefactis fungorum carnosorum crescens.

Type species: *Collybia olympiana* Smith. Contrib. Univ. Mich. Herb. No. 5:13. 1941.

Habit collybioid, pileus some shade of grey or fuscous at first, changing gradually to rather bright reddish tones at maturity, near "ochraceous-tawny" or "cinnamon-brown"; no cystidia; spores echinulate, with rather short, coarse, blunt-pointed projections, ovate to subglobose; on decayed remains of fleshy fungi; with one species in this area.

Smith considers *Collybia olympiana* very closely related to *Collybia tylicolor* and *Collybia erosa* of Europe, which have the same echinulate spores and color change from fuscous to reddish tones at maturity. However, the two latter species are now frequently considered in the genus *Lyophyllum* (Kuhner and Romagnesi, 1953; Metrod, 1952). In contrast, at least in the dried condition, the basidia of *C. olympiana* are not carminophilous.

1. Rhodocybe olympiana (Smith) Lennox comb. nov. Figure 1
Basionym: Collybia olympiana Smith. Contrib. Univ. Mich. Herb. No. 5:13. 1941.
Illustrations:
Smith, *Ibid.*, Plate I.

PILEUS 1 - 2.5 cm broad, convex or with a slight obtuse umbo when young, the margin incurved, becoming broadly convex, plane, or with a low obtuse umbo and a decurved margin in age, surface covered at first by a thin coating of silvery fibrils giving the cap a silvery appearance, "hair brown" to pale lead color beneath the fibrils, glabrescent or remaining faintly silky, the disk becoming "mummy brown" and the margin whitish or merely "avellaneous" over all, then gradually changing to brown and finally becoming "ochraceous-tawny" over the marginal area and "cinnamon-brown" (bright reddish brown or rusty brown) over the disk, translucent-striate in age and then appearing hygrophanous, fading very slowly; flesh thin, soft, concolorous with the surface, odor and taste strongly farinaceous.

LAMELLAE adnate, very pale whitish grey when young, slowly becoming sordid brown, edges even, close, 25-27 reach the stipe, two tiers of shorter individuals, broad and becoming ventricose (about 3 mm).

STIPE 4-6 cm long, 2-2.5 (3) mm thick, surface at first coated with pale silvery grey fibrils (similar to those of the pileus) and appearing greyish, sometimes minutely squamulose above, slowly glabrescent, becoming sordid tawny brown in age, base sparsely fibrillose to mycelioid and deeply sunken into the substratum; equal and flexuous, cartilaginous, hollow, no sclerotium present.

SPORES 6-7 x 4.5 x 5 µm, broadly ovate to subglobose, echinulate, hyaline, rather thick-walled, nonamyloid, and white in deposit; BASIDIA 22-28 x 7-9 µm, four-spored, with large rather stout sterigmata, not carminophilous when tested in the dried condition; TRAMA of large diameter cells (7-25 µm), parallel, clamped, and slightly dextrinoid; no cystidia differentiated, PILEAL SURFACE a cutis of only slightly narrower cells and not gelatinized, sordid yellowish in iodine.

MACROCHEMICAL REACTIONS: No data available.

MATERIAL STUDIED: WASHINGTON, Clallam Co., Sm 14537 (paratype - Crescent Beach); CANADA, ONTARIO, Sm 4527 (paratype - Lake Timigami).

This apparently very rare and very distinct species is difficult to place in any of the collybioid groups. Smith remarked that "the Ontario specimens were old when collected, and the dark reddish brown colors caused me to place them tentatively near Collybia nitellina"; this resemblance is still quite evident in those same specimens in the dried condition. It was this rather striking resemblance as well as the lack of a more suitable taxonomic position, that has prompted me to place this species tentatively in the genus Rhodocybe. It, nonetheless, is strikingly different from the other species of the genus in the ornamentation of its spores, and according to Smith the spore print is white. It is conceivable that, as the carpophores are fairly small and fragile, the spore deposit was thin and any pale pinkish spore color would appear white. It is also possible that this species is closer to a Lyophyllum, and perhaps the carminophilous reaction is lost in drying and with age. Until more information is available on spore print color and carminophilous nature in the fresh condition of the basidia, this species will remain difficult to place.

Section Nitellinae (Sing.) Sing. Agar. Mod. Tax. Lilloa 22:308. 1949. (publ. 1951).

Type species: Rhodocybe nitellina (Fr.) Singer. Agar. Mod. Tax. p. 677. 1962

Habit collybioid, sometimes resembling a Hebeloma or a small Tricholoma; pileus some shade of rusty orange, fulvous, deep cinnamon, brownish yellow, or tan, not darker and with blacker tones in young specimens; no cystidia, or clavate and not exceeding the basidioles; spores coarsely roughened to subangular, especially in end view; terrestrial or on wood.

The species of this section seem somewhat heterogeneous in macroscopic character but are easily recognized by their small collybioid carpophores, pink spore print, roughened non-angular spores and lack of cystidia.

Key to the Species of Section Nitellinae

1. Carpohores fulvous or rusty colored throughout, terrestrial, solitary to scattered..Rhodocybe nitellina (p. 139).
1. Carpohores in part some shade of warm tan to pinkish buff, never a fulvous or rusty orange, generally on wood, gregarious to caespitose.................... 2.
    2. Carpophores uniformly tan or pinkish buff, resembling a small Hebeloma, spores ellipsoid, 7-10 x 4.5-6 µm... Rhodocybe roseiavellanea (p. 140).
    2. Carpophores not uniformly colored, having a warm tan cap, rosy-pink gills at maturity, and a pallid to yellowish stipe; collybioid, spores subglobose to ovate, 5-6.5 x 4.5-5.5 µm................................ Rhodocybe speciosa (p. 143)

2. Rhodocybe nitellina (Fr.) Singer, Agar. Mod. Tax. p. 677. 1962. Figure 3; Plate I

Basionym: Agaricus nitellinus Fries. Epic. Syst. Mycol. p. 80. 1838.
Synonyms: Collybia nitellina (Fr.) Quél. Les Champ. Jur. Vosges Soc. Emul. Montbéliard, sér. II, 5:434. 1875.
Gymnopus sublatericius Murrill, N. Am. Flora 9(5):369. 1916.
Collybia sublatericia (Murr.) Murr. Mycologia 8:219. 1916.
Rhodopaxillus nitellinus (Fr.) Singer Das System der Agar., Ann. Mycol. 41:90. 1943.
Illustrations: Fries, Icones Hymenom., tab. 65, fig. 1-2; Britz, Hymenon, tab. 100, fig. 525; Cooke, Illustr. Brit. Fungi, tab. 146.

PILEUS 1.2-3.7 cm, evenly orangish or pinkish cinnamon (7E8 to 5B6), occasionally darker centrally, hygrophanous and changing colors only slightly (7C7 or 6C7), convex becoming plane, often centrally depressed, more rarely with a broad shallow umbo, margin even, becoming frayed or almost crenate in large and old specimens; surface glabrous, moist, dull, translucent-striate for half the radius, margin becoming somewhat plicate in older specimens, context very thin (1 mm), concolorous, hygrophanous, rather tough, almost pliable; taste and smell strongly farinaceous.

LAMELLAE pinkish buff (5A4 to 5A3), or with a stronger incarnate tinge, occasionally staining faintly yellowish where bruised, edges even, adnate to emarginate-uncinate, thickish, broad, 5 mm x 11 mm, subdistant, 28 gills reaching stipe apex.

STIPE 2-6.4 cm x 2-8 mm, concolorous with the cap or only slightly lighter, uniformly colored, equal, occasionally slightly larger toward the apex, surface undulate to knobby, and with the fibers often twisted, glabrous above a fine appressed white coat of mycelium at very base, shining, terete to compressed in larger specimens, flexuous, solid with a somewhat lighter core, fragile to almost brittle.

SPORES 7-11 x 4.5-6 µm, thick walled, coarsely roughened, sometimes rather faintly so, never appearing really angular either in polar view or profile, rather dark salmon brown in deposit, ovate to ellipsoid, nonamyloid; BASIDIA 26-33 x 6-8.5 µm, elongated, expanded toward apex, rather narrow in lower half, occasionally entirely four-spored, more often mixed, some collections with only two-spored basidia; no cystidia differentiated; GILL TRAMA parallel of short, broad, clamped cells, 4-19 µm in diameter, averaging 10 µm, PILEAL SURFACE undifferentiated or with only uppermost cell layer somewhat narrower than the contextual hyphae, nonamyloid, not encrusted; CONTEXT composed of entirely radial hyphae which are rather short and broad, 10-15 x 37-50 um, nonamyloid.

HABITAT: solitary, sometimes scattered; in dense conifer woods; autumn or spring.

MACROCHEMICAL REACTIONS: Gills and the flesh of the cap react positively with alpha-napthol, and guaiacol. Reactions with tincture of guaiac and ferric sulfate are either faint or sporadic.

MATERIAL STUDIED: WASHINGTON, San Juan Co., W542, W1076, W1323, W1748 (Friday Harbor Biological Station); Jefferson Co., W1011 (Quilcene turnoff); Mason Co., W1175, (Staircase); Thurston Co., W498, W1260; Skagit Co., W1694 (Mineral Park); Snohomish Co., W1148 (S. of Darrington); King Co., W1132 (McClellan's Butte); Pierce Co., W1216 (Ipsut Creek); Okanogan Co., W637 (Early Winters Camp); Skamania Co., W1276 (Cispus); IDAHO, Bonner Co., W926 (Chase Lake).

2. Rhodocybe roseiavellanea (Murr.) Singer. Agar. Mod. Tax.:677. 1962. Figure 2; Plate I.

Basionym: Pleuropus roseiavellaneous. Murrill. Mycologia 30:367. 1938.

PILEUS 1.1-3.2 cm, buff to a rufous tan (5A5 to 6D5), uniformly colored or somewhat lighter toward center, subhygrophanous and hardly changing color; convex, then plane, often centrally depressed, margin regular and remaining inrolled or becoming straight; surface glabrous, never really moist or shining, dull-matte, sometimes appearing finely fibrillar under a lens, not translucent-striate, sometimes split, not frayed at the margin; context firm, tough, not pliable, somewhat corky, concolorous; odor none to aromatic, taste fruity to farinaceous.

LAMELLAE tan to pinkish buff (5A2 to 6B3), broadly adnate emarginate, insertion variable, rather broad to very broad, 6 x 10 mm, subcrowded, sometimes rather thin as well, edges concolorous and even but generally wavy and often splitting, 3-4 tiers, sharp-pointed towards the margin and blunt at the stipe, somewhat ventricose.

STIPE 3.5-7.5 cm x 2-9 mm, concolorous with the gills or somewhat darker (5A2 to 7D4), uniformly colored, equal or tapering slightly downward, terete to compressed, flexuous at the base, surface glabrous, dull, finely grooved or

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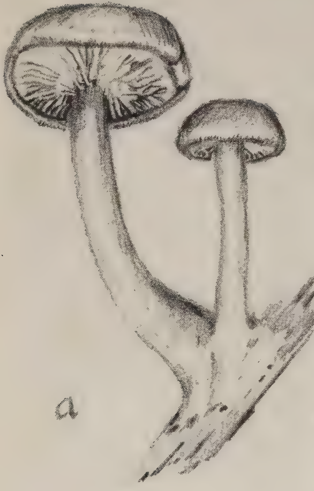
PLATE I: a - Rhodocybe speciosa nom. prov. W1502, xl; b - Rhodocybe roseiavellanea W1294, x 1; c - Rhodocybe nitellina, W1175, W1148, x 1; d - Rhodocybe aureicystidiata nom. prov., W1319, x 1.

I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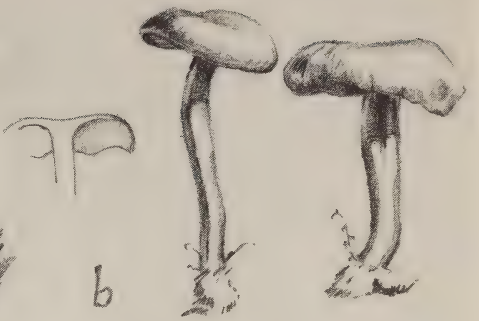
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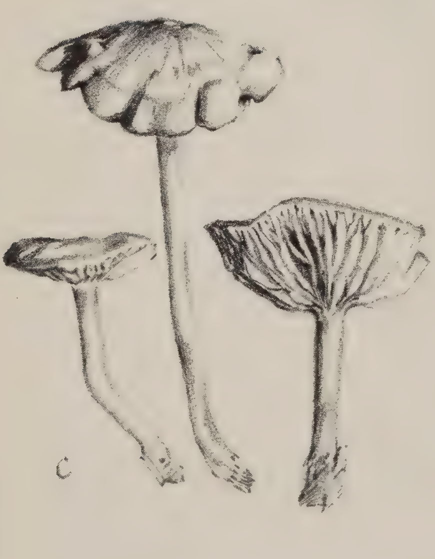
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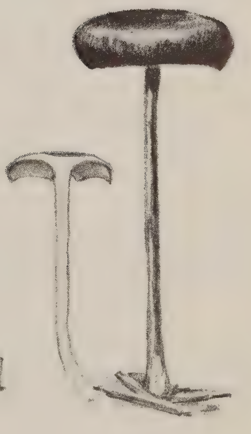
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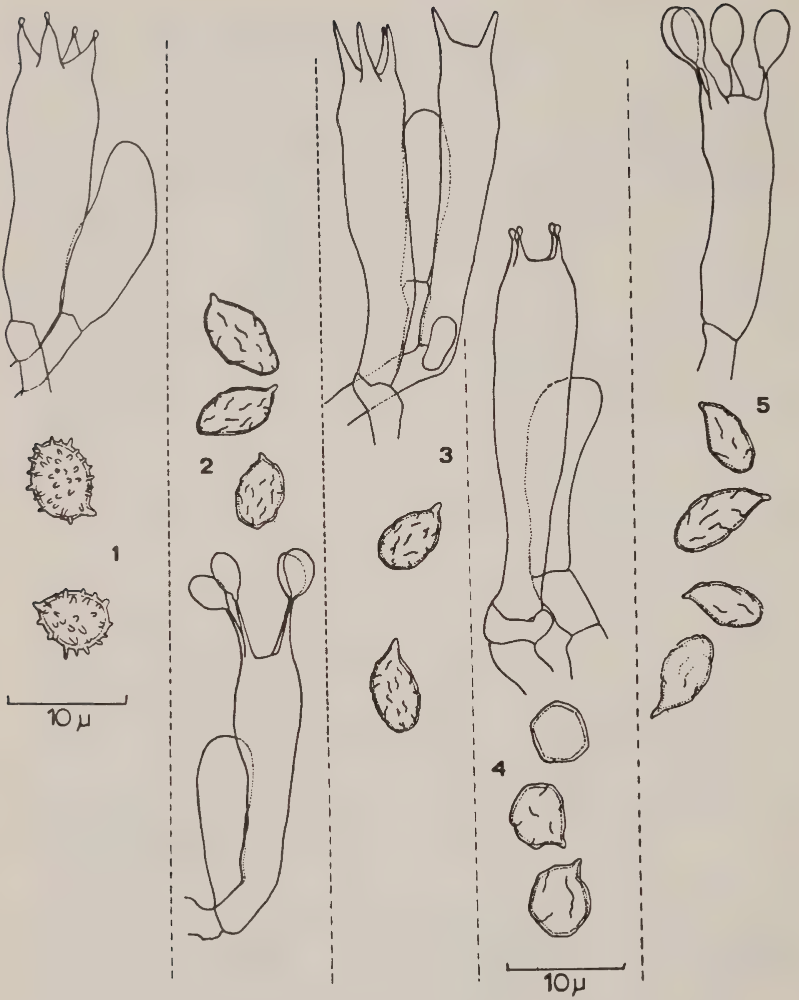

Figure 1. - Rhodocybe olympiana, AHS. 4527; Figure 2. - Rhodocybe roseiavellanea, W1295; Figure 3. - Rhodocybe nitellina, W1076. basidia and spores.

Figure 4. - Rhodocybe speciosa nom. prov., W1533, basidium and spores; Figure 5. - Rhodocybe aureicystidiata, W1319, basidium and spores.

striate occasionally, and then silky, not moist, base with a matted yellowish tomentum or without, generally very tightly adherent to the substratum by short white rhizomorphs.

SPORES (6) 7-10 x 4.5-6 µm, ovate to ellipsoid, rather coarsely roughened, a minority of the spores appearing angular in polar view, rather thick-walled, monamyloid; BASIDIA 22-31 x 5-7 µm, rather narrow, thin-walled, nonamyloid, two-spored, four-spored, or more often mixed, exceeding basidioles by 4-10 µm; GILL TRAMA parallel, without clamps, hyphae 2-15 µm in diameter; no cystidia differentiated, or present but not appreciably different than the basidioles, PILEAL SURFACE undifferentiated or with a very thin cutis, sometimes encrusted or subgelatinized, without clamps, nonamyloid, the PILEAL CONTEXT more or less radial, averaging 4-8 µm in diameter.

HABITAT: Gregarious to caespitose, on decayed wood or Douglas fir cones, sometimes terrestrial under redwood or fir.

MACROCHEMICAL REACTIONS: Gills and the flesh of the cap react faintly with guaiacol; reactions with sulfoformol (yellow) and ferric sulfate (grey-green) were sporadic.

MATERIAL STUDIED: WASHINGTON, San Juan Co., W1294 (Friday Harbor Biological Station); Kitsap Co., W950 (Symington Lake), King Co., W1060 (Snoqualmie Pass); CALIFORNIA, Mendocino Co., W1335 (Woodlands Camp).

The Washington and California material studied seem to agree fairly closely with the Murrill description of this species; it does differ in a number of characters and after examination of the type and further study of variation in the species, it may warrant being given specific status. The Murrill Florida species is described as having adnate to short-decurrent, medium-distant gills, a stipe up to 1 cm thick and bulbous at the base, and spores which are pink but smooth and ovoid; no mention of clamps is made. In addition, this species occurred under live oaks. A heavy reliance has been placed on the fact that Singer (1962) placed this species in the genus Rhodocybe; presumably he had examined the type material and found the spores actually to be rough-walled, and the carpophores lacking in clamps.

4. Rhodocybe speciosa nom. prov. Figure 4; Plate I.

PILEUS 1.4-3 cm, tan or honey-brown (5C5 to 5E5), uniformly colored, hygrophanous and drying in a streaked manner to a light warm tan (5B3 to 5C4); convex and becoming almost plane, even and symmetrical, sometimes shallowly depressed at the center, margin inrolled to parallel with the stipe, not raised above the point of gill attachment; surface even, dry, and glabrous, occasionally appearing somewhat powdery, not translucent-striate; context rather thick, 2-3 mm, concolorous, dry, firm-fibrous, almost tough; odor faint to distinct and then farinaceous with a strong sweet tone, taste delayed farinaceous, strong.

LAMELLAE almost white in young specimens, turning rapidly pink or light pinkish orange (5A3 to 6B3), edge concolorous, and even or serrulate, thinnish and subdistant, 48-56 lamellae reaching stipe apex, 4-5 tiers; broad, 7 x 13 mm, consistency rather soft, sharply sinuate but attached broadly, amost uncinate but never appearing subdecurrent, easily seceding; hardly ventricose and blunt-pointed both at the margin and stipe.

STIPE 3-4.5 cm x 3-8 mm, light yellow to pale orangish (5A4 or 5B4) at the apex, uniform or darkening slightly downward (5B5), perhaps yellowing in handling; expanded just at the top and base, equal between, surface moist but rather dull, thinly powdery-pruinose at the apex, appearing finely silvery-fibrillar streaked midway and especially in drying, with a white matted basal tomentum, flexuous, solid to hollow, terete or compressed in larger specimens, frequently connate at the base, without rhizomorphs.

SPORES 5-6.5 x 4.5-5.5 µm, subglobose to broadly ovate, coarsely roughened or wrinkled-angular, appearing angular in polar view and occasionally in profile as well, rather thick-walled, nonamyloid, deep pink to salmon brown in deposit (7C6); BASIDIA 24-31 x 7-8.5 µm, four-spored, cylindrical to abruptly expanded in upper half, nonamyloid and noncarminophilous; GILL TRAMA parallel and CLAMPED, nonamyloid, 3-12 µm in diameter, faintly encrusted (?), with a very narrow subhymenium; PILEAL SURFACE undifferentiated, surface hyphae somewhat enlarged over those of the context (6-10 µm, averaging about 7-8 µm in diameter), radial, thinly encrusted, almost cystidiate but entirely repent, nonamyloid and clamped; PILEAL CONTEXT of rather compact hyphae 3-8 µm in diameter (average about 5 µm), nonamyloid; no cystidia differentiated, basidioles sometimes appearing rather vesicular and cystidiate.

HABITAT: Gregarious to caespitose on decayed wood in coniferous woods.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react positively with aniline (peach pink), phenol, phenol-aniline, and ferric sulfate. There was variability in reactions to tincture of guaiac, formol (gills reddish), and sulfoformol (olive).

MATERIAL STUDIED: WASHINGTON, King Co., W1533 (Denny Creek), W1502 (Snoqualmie River near North Bend); Pierce Co., W1701 (Tahoma Creek, Mt. Rainier National Park).

This is a handsome species of Rhodocybe which is easily characterized by its pink gills, yellowish stipe, fragrant-farinaceous odor and taste, subglobose subangular thick-walled spores, and its reactions with aniline, phenol, and phenol-aniline only, which is unusual since most Rhodocybes react with guaiacol, and alpha-napthol as well.

Section Rhodocybe Singer. Agar Mod. Tax.: 678. 1962.

Type species: Rhodocybe caelata (Fr.) Maire. Bull. Soc. Mycol. Fr. 40:298. 1925.

Pileus variously colored, habit collybioid to clitocyboid, pleurocystidia present, striking, colored, often continuous with a conducting system in the trama, spores roughened, not subangular, without clamps.

The species of this section probably form a natural unit, and are easily distinguished on a microscopical basis. There is one species of the section in this area.

5. Rhodocybe aureicystidiata nom prov. Figure 6; Plate I.

PILEUS 1.4-2.4 cm, dark fuscous brown, hyrophanous and drying somewhat lighter (5F5, then 5E4), stains dark red where bruised or decayed, this reaction easily overlooked due to the dark color of the carpophores; convex and then plane and then shallowly depressed, margin even and remaining inrolled at maturity, surface moist, glabrous, drying dull-matte, context concolorous, firm, rather thin, almost tough; taste and odor none.

LAMELLAE almost concolorous with the drying cap, or with a stronger pinkish tone (5C4), broadly adnate to shallowly emarginate-uncinate, not really appearing subdecurrent at maturity, easily seceding, blunt-pointed at the stipe, somewhat pointed toward the margin, rather thick and distant, 20-24 lamellae reaching stipe, broad, 7-8 mm x 4 mm, consistency brittle, edges even but somewhat lighter.

STIPE 4.5 -6 cm x 2-3 mm, darker than drying cap, fuscous brown (6F3), staining dark reddish where bruised or with age, equal, strict or flexuous, surface moist, shining and glabrous, with a white appressed fibrillose mat at the base, solid, firm, somewhat pliant, not really tough.

SPORES 7-8.5 (11) x 3.5-5.0 µm, ellipsoid, coarsely roughened, not angular in polar view or profile, nonamyloid, thick-walled, with a long, sharp apiculus; BASIDIA 27-34 x 6-7 µm, elongate, four-spored; GILL TRAMA parallel, without clamps, with laticifer-like conducting elements filled with yellowish refractive granular material, composed of hyphae 3-16 µm in diameter, with a rather deep interwoven subhymenium, nonamyloid; CHEILOCYSTIDIA and PLEUROCYSTIDIA similar, abundant, striking, occasionally continuous with the con-

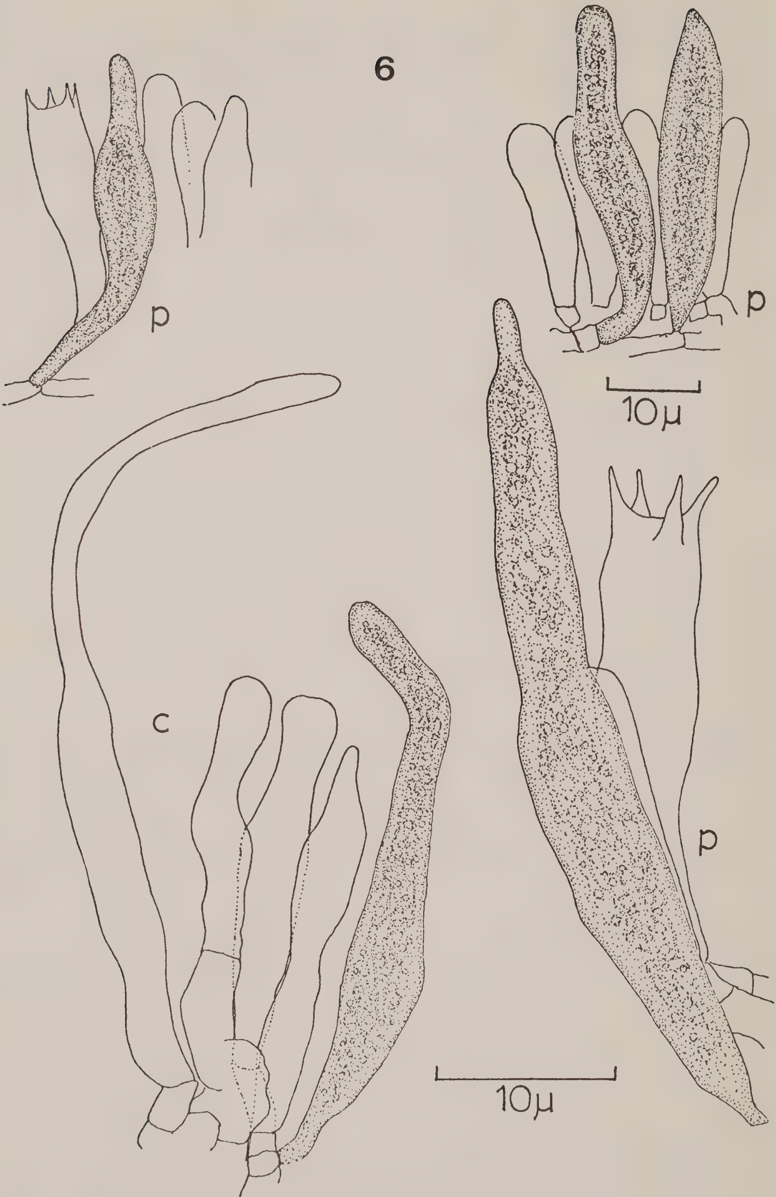
6
p
p
c
p
10µ
10µ

Figure 6. - Rhodocybe aureicystidiata nom. prov. W1319, cheilocystidia (c), pleurocystidia (p).

ducting system of the trama, filled with yellowish, refractive, granular material, clavate-acuminate to filamentous, 39-60 x 5-7 µm, nonamyloid; no other cystidia differentiated; PILEAL SURFACE a cutis of narrow repent, radial hyphae, intergrading with the contextual hyphae in size and compactness, encrusted in irregular patches giving the wall a beaded appearance in profile, 1-4 µm in diameter; CONTEXTUAL HYPHAE mostly radially oriented, rather compact, and composed of hyphae 4-20 µm in diameter; STIPE composed of hyphae oriented longitudinally, narrow, 2-3 µm in diameter on the outside, less compact toward the center, thin-walled (less than 1 µm), not encrusted, without clamps.

HABITAT: Scattered to solitary under conifers.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react positively with aniline (apricot orange), alpha-napthol, guaiacol, tincture of guaiac, formol (olive green), sulfoformol (orange yellow), phenol (faint, orangish), phenol-aniline (apricot), and ferric sulfate. The cystidia and conducting elements of the trama were sulfobenzaldehyde negative.

MATERIAL STUDIED: WASHINGTON, Thurston Co., W1319 (Miller-sylvania); CALIFORNIA, Mendocino Co., W128 (15 mi. N. of Willits); Humboldt Co., W169 (Patrick Point State Park).

This species is very close to the type species of the genus, Rhodocybe caelata (Fr.) Maire, and the microscopic characters seem to differ only in one respect: the cystidia of R. caelata are much longer (60-80 x 6-7 µm). From a macroscopic view however the two species appear to diverge rather markedly: while R. caelata has greyish colors on the cap and stipe, these lack the dark fuscous, almost black tones found in R. aureicystidiata; R. caelata is also described and illustrated by Maire (1925 as being deeply umbilicate, having pinkish buff gills which are deeply decurrent even in immature specimens, lacking the dark reddish staining reaction, and occurring under hardwoods, especially Quercus - all characters distinctly different from those of R. aureicystidiata nom. prov.

CALLISTOSPORIUM Singer. Mycol. 36:363 1944.

Synonyms: Collybia Kummer pro parte. Führ. Pilzk. p. 26. 1881.
Gymnopus Roussel. Fl. Calvados ed. 2 p. 62. 1806.

Type species: Callistoporium palmarum (Murrill) Singer.

PILEUS collybioid, convex and then plane, either umbilicate or umbonate, but not strongly so; context generally thin and firm; pigmentation in the fresh condition some shade of yellow or tan with a strong olivaceous tone, hygrophanous, changing to a dark vinaceous brown in the dry condition; odor frequently farinaceous, taste generally strong.

LAMELLAE adnexed to adnate, concolorous with the cap or yellow, edges concolorous and even, often with a rather waxy appearance, thick and subdistant, spore print white, sometimes changing in drying to a faint flesh color.

STIPE concolorous with the cap, central, equal, faintly fibrillar-streaked to almost scurfy, generally rather tough, not pliant, changing like the cap to a dark vinaceous brown.

SPORES subglobose to ellipsoid, at least 4 x 3.5 µm, hyaline in the fresh condition, pigmented in the dried condition, the pigment intracellular and discrete or dispersed, stramineous to vinaceous, generally darker and more vinaceous in 3% KOH, present in a small percentage of the spores; BASIDIA four-spored, some pigmented like the spores; CHEILOCYSTIDIA general absent, if present then filamentous to clavate, generally somewhat irregular and contorted, hyaline, rarely longer than the basidia; no PLEUROCYSTIDIA; PILEOCYSTIDIA differentiated or more rarely absent, clavate to filamentous, grouped or scattered; PILEAL SURFACE a cutis of radial, repent, pigmented hyphae, somewhat smaller than those of the context; LACKING CLAMP CONNECTIONS.

HABITAT: Solitary to caespitose on much decayed wood in mixed or coniferous woods.

MACROCHEMICAL REACTIONS: The species of this region react very faintly or not at all with most spot tests employed. Ferric sulfate tends to deepen the greenish color of the carpophores, and sulfoformol makes them yellower.

This genus is easily differentiated from other genera by its collybioid, lignicolous habit, striking color change from the fresh to dried condition, the intracellular pigment, and the lack of clamp connections.

Key to the *Callistosporium* Species

1. Pileus generally smaller than 2 cm, convex, margin remaining inrolled, not centrally depressed, spores 6.5-8 x 4-5 µm............. *C. graminicolor* (p. 152)

1. Pileus often larger than 2 cm at maturity, convex and then plane, generally shallowly umbilicate to centrally depressed, spores 4-5.5 x 3.5-4.5 µm.... .... *C. luteo-olivaceum* (p. 148)

6. *Callistosporium luteo-olivaceum* (Berk. & Curt.) Singer. Lilloa 22:233. 1951. Figure 7, Plate II.

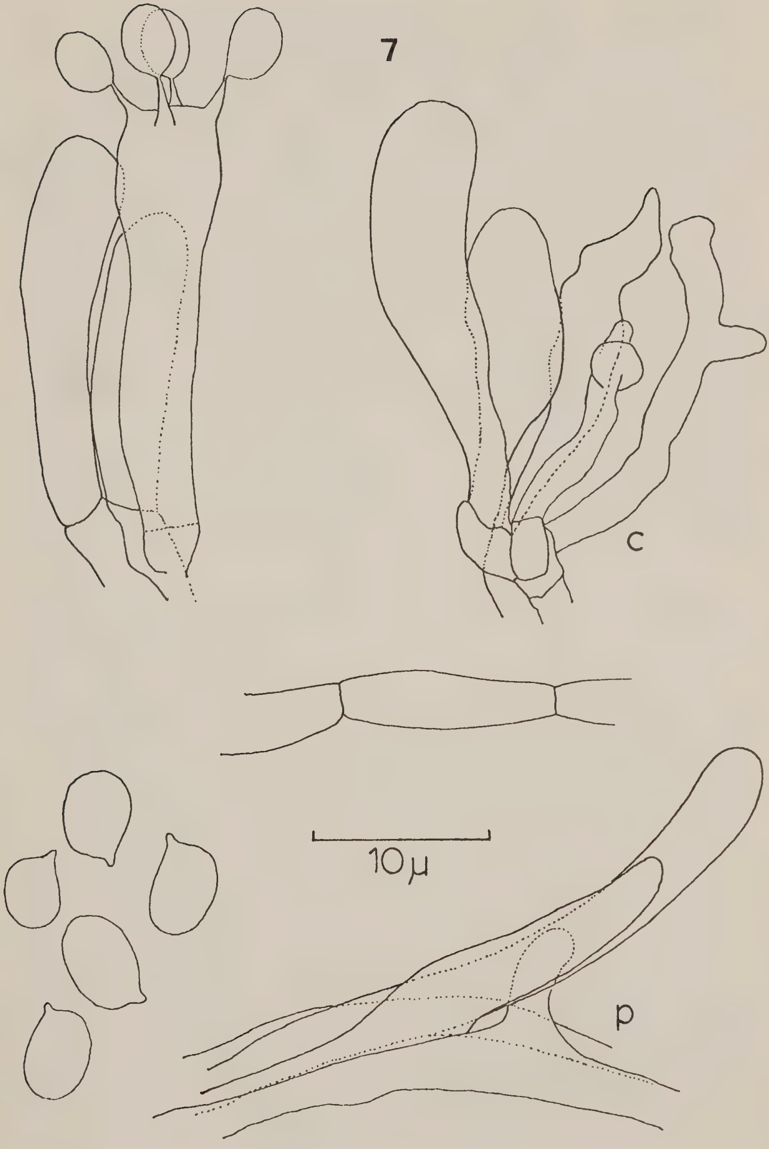

Figure 7. - Callistosporium luteo-olivaceum, Peck type, basidium, hyphae and spores; W1156, cystidia on pileal surface (p), cheilocystidia (c).

Basionym: *Agaricus luteo-olivaceus* Berk. & Curt.
Ann. Mag. Nat. Hist. IV, 3:286. 1859.
Synonyms: *Collybia luteo-olivacea* (Berk. & Curt.)
Sacc. Syllo. Fungorum 5:215. 1887.
Collybia colorea Peck. N.Y. State Mus.
Rep. 26, 1874.
Callistosporium psilocybe Murr. & Singer.
Mycologia 36:363. 1944.

Illustrations: Lloyd, Mycol. Notes 5(1900), p. 37,
fig 8 (as *Collybia colorea*).

PILEUS 1.5-6.5 cm, averaging 3 cm, at first a decided dark olive green (5F7), hygrophanous and changing slowly to more brownish tones (5E6, 5E7, and 5D6), finally a golden olive to golden brown (4C5); becoming a dark vinaceous or vinaceous cinnamon (9F7) through drying; convex, becoming expanded and plane to shallowly umbilicate, more rarely shallowly umbonate, margin at first scarcely involute, soon plane, entire and even; surface at first entirely covered with a pruinose bloom of fine tomentum, soon glabrescent, smooth and even, nearly lubricous to matte when fresh and moist; context thin and firm, not pliant-tough; smell pungent, resinous to aromatic, like rotting pears or moldy cinnamon, taste mild, farinaceous-fungoid.

LAMELLAE golden yellow (4A4), abruptly sinuate, uncinate, tapered and pointed toward the margin, subventricose, sometimes moderately broad, 5-6 x 12-20 mm, somewhat close, 40-52 reaching stipe apex, 4 tiers, rather thin.

STIPE 2.7-6 (7) cm x 3-9 mm, concolorous with the cap the entire length or somewhat darker in the lower half (5E7), with a thin, appressed sulphur yellow tomentum at the very base; equal or slightly expanded at the apex, sometimes terete, usually flattened; surface even, dry, when young entirely pruinose-tomentose with a bloom like the pileus, retaining this downward, becoming glabrous or sparsely fibrillose above, hygrophanous and then becoming streaked; base concrescent with the rotten wood, hollow, context tough, elastic, hygrophanous, dark olivaceous, the cavity lined with looser bright sulphur yellow material.

SPORES subglobose to broadly ovate, 5.0-6.5 x 3-4.5 µm, with a prominent apiculus and 1-2 guttulae, a minority containing a discrete or dispersed pigment, visible in examination only of dried material, straminous to vinaceous in transmitted light, darker vinaceous in 3% KOH, noncarminophilious, nonamyloid; BASIDIA 22-30 x 6-7.5 µm, four-spored, noncarminophilous; CHEILOCYSTIDIA generally present, incon-

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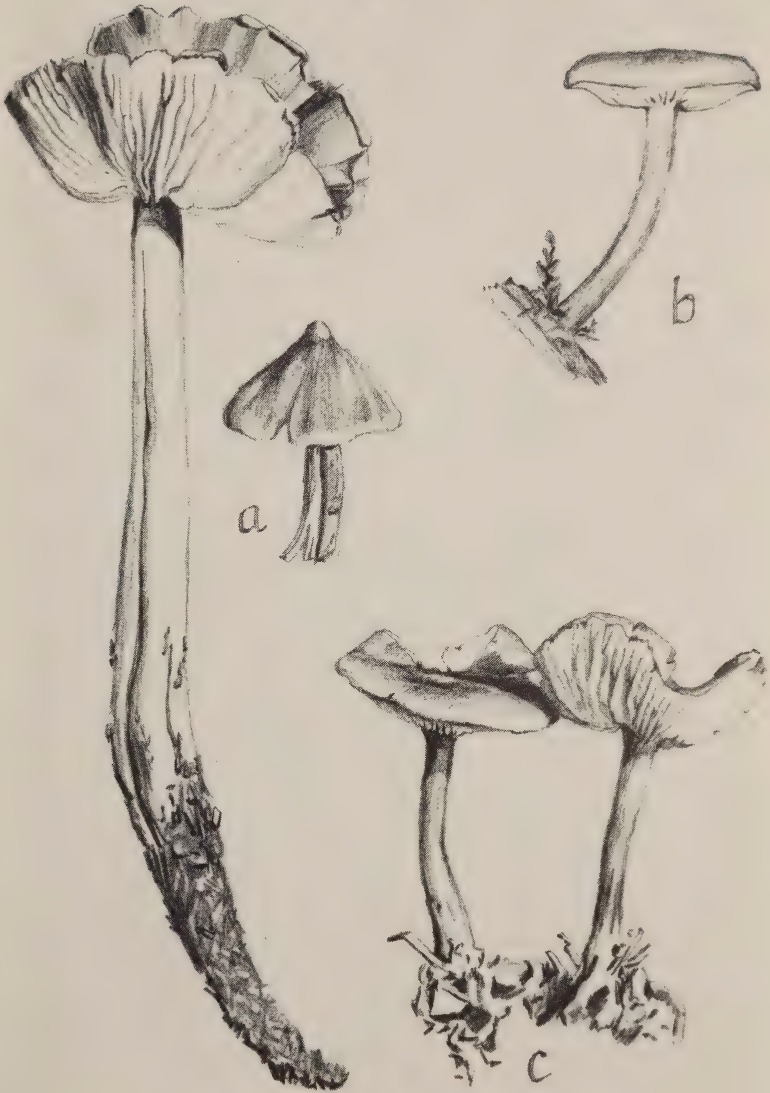
PLATE II -; a - *Caulorhiza umbonata*, W1338, x 1; b- *Callistosporium graminicolor*, W1713 x 2; c - *Callistosporium luteo-olivaceum*, W1156, x 1.

II



spicuous, clavate to filamentous, usually with a contorted appearance, sometimes sparingly branched, rarely exceeding the basidia, 10-39 x 2.5-5 µm, hyaline; PLEUROCYSTIDIA not differentiated; PILEOCYSTIDIA present or absent (especially in older specimens), clavate to filiform, hyaline, not encrusted, often grouped, arising directly from the cutis surface as swollen and upturned hyphal ends, 5-25 x 26 µm; PILEAL SURFACE a cutis of radial, repent hyphae 2-4 µm in diameter, filled with pigment, overlying larger, less compact, unpigmented hyphae of the context 3-7 µm in diameter; GILL TRAMA parallel, regular, of hyphae 4-13 µm broad.

HABITAT: On much decayed wood, often buried, in mixed or coniferous woods, scattered to caespitose.

MACROCHEMICAL REACTIONS: Ferric sulfate deepens the olive color of the carpophores, and sulfoformol lightens and yellows the color.

MATERIAL STUDIED: WASHINGTON, Grays Co., W1321 (Twin Harbors State Park); King Co., Stz 1453, 1454 (University of Washington campus), W540 (Mercer Island), W1156 (Water Main Woods); Skagit Co., W496 (Bowmans Bay); NEW YORK (North Green bush), Peck Type (*Collybia colorea* var. *rubescentifolia*).

This species is closely related to the following species and is best distinguished by its smaller, more ovate or globose spores. In addition, it is generally much larger and more robust, the gills and stipe more olive than golden, the stipe hollow, the gills are thinner and more crowded, cheilocystidia although inconspicuous are generally present, and it rarely occurs solitarily.

7. *Callistosporium graminicolor* Lennox sp. nov. Plate II.

Pileus 1.2-1.8 cm latus, flavobrunneus, hygrophanus, convexus, dein planus sed nec depressus nec umbilicatus, pagina pilei sicca vel humida, glabra vel pruina tenui obtecta; odor farinaceus vel aromaticus, sapor amarus; lamellae aureae, sinuatae, aliquantum latae, subdistantes, ceraceae. STIPES 2.7-3.5 cm longus, 2-3.5 mm crassus, aureus, in medio infero fuscatus, ad basim tomentum tenuem aureum praebens, aequalis, teres, solidus. sporae 6-8 x 4-5.5 mµ, ovatae, inamyloideae, in sicco pigmentum vinaceum praebentes. Basidia 20-27 x 6-7 mµ, tetraspora. Cheilocystidia et pleurocystidia desunt. Trama lamellarum parallela, efibulata. Pagina pilei e cute hypharum angustarum repentium radiantum constanti, in sicco pigmentum vinaceum praebentium. Holotypus W626, herbario Universatitis Washingtoni conservatus.

PILEUS 1.2-1.8 cm, yellow brown to fuscous yellow brown on the disc, 5E6 to 5E8, hygrophanous and becoming more yellowish and less olivaceous in drying, 4D4 to 4C6; convex and then plane, margin remaining strongly inrolled, never straight, regular and symmetrical, neither umbilicate nor umbonate; surface dry, occasionally waxy-moist, coated with a very fine pruinose bloom, appearing glabrous when quite moist and with age, smooth and even, context firm, concolorous, moderately thick, 1-2 mm. over the disc; smell farinaceous to aromatic or like eucalyptus, taste bitter or acrid, becoming farinaceous later.

LAMELLAE amber yellow to golden yellow, 4B6 to 5B7, abruptly sinuate, occasionally approaching emarginate, not uncinate, bluntly pointed both at the stipe and cap margin, ventricose, rather broad, 6 x 2.5 mm, subdistant, 28 reaching the stipe apex, 4 tiers, edge even and concolorous, consistency somewhat soft and generally waxy although not especially thick.

STIPE: 2.7-3.5 cm x 2-3.5 mm, golden yellow and concolorous with the gills for most of the length, darkening in the lower half with age and probably with handling (5E7); faintly yellow powdery at the very base with a very fine appressed scant tomentum (3A4); tapering downward or equal, terete, never compressed or flattened; surface dry, naked to sparsely clothed with a pruinose tomentum toward the base, subhygrophanous, flexuous at the base, solid and rather tough, context concolorous.

SPORES 6-8 x 4-5.5 µm, broadly ovate, lacking any marked suprahilar depression, apiculus prominent, uniguttate, nonamyloid, a minority containing a discrete or dispersed necropigment, visible in examination of dried material, stramineous to light vinaceous in transmitted light, darker vinaceous in 3% KOH, the pigment and reaction with alkaline occasionally very weak in some collections, noncarminophilous; BASIDIA 20-27 x 6-7 µm, four-spored noncarminophilous; PLEUROCYSTIDIA and CHEILOCYSTIDIA not differentiated; GILL TRAMA regular and parallel, without clamps; PILEAL SURFACE a cutis of radial, repent, narrow hyphae filled with necropigment and overlying the larger, less compact hyphae of the context, these unpigmented and rather strongly constricted near the end walls, giving a catenulate appearance to the hyphae, CLAMPS absent both in the surface and context cells.

HABITAT: On much decayed wood in mixed woods, solitary to scattered.

MACROCHEMICAL REACTIONS: Ferric sulfate deepens the olive color of the carpophores, and sulfoformol lightens and yellows the color. There were, in addition, faint and ambivalent reactions with alpha-napthol and tincture of guaiac.

MATERIAL STUDIED: WASHINGTON, King Co., W626 (Lee Forest), W1706 (Seattle, Carkeek Park), W1713 (Totem Lake).

CAULORHIZA Lennox nom. nov.

Habitus collybioideus, pileus 4-8.7 mm latus, fulvus, conicus dein planus, umbonatus, plicato-striatus, glaber; odor atque sapor haud proprius; lamellae pallide ocraceae, crassae, crebrae. Stipes 4.5-23 cm longus, 8-14 mm crassus, magis pallidus quam pileo, bubalinus, supra superficiem terrae aequalis, infra superficiem angustatus, per quasi dimidium longitudinis infossus, glaber vel canescens, impolitus, cavus, fibrosus. Sporae 5.5-7.0 x 3.0-3.5 mµ, ovatae vel ellipsoideae, laeves, hyalinae, amyloideae; pleurocystidia clavata, tumida, 60-82 x 11-14 mµ; pagina pilei e cute laxa pileocystidiis clavatis, per zonam subcellulosam subtenta, fibulas praebens.

Type species: Caulorhiza umbonata (Peck) Lennox comb. nov.

PILEUS 4-8.7 cm broad, light tawny to tawny grey, hygrophanous, broadly campanulate or conic, expanding to almost plane, with a prominent umbo, margin frayed or split, plicate-striate, glabrous; LAMELLAE light ochraceous, deeply sinuate, broad, thick, crowded; STIPE 4.5-23 cm long, 8-14 mm broad, paler than the cap, light tawny to buff, equal above ground, tapering downward from ground level, glaucous or powdery, finely striate, hollow, fibrous, rooting for one half of its length; SPORES 5.5-7.0 x 3.0-3.5 µm; ovate to ellipsoid, smooth, thin-walled, amyloid; PLEUROCYSTIDIA 60-82 x 11-14 µm; clavate-inflated; PILEAL SURFACE a cutis with pileocystidia subtended by a subcellular layer, clamped.

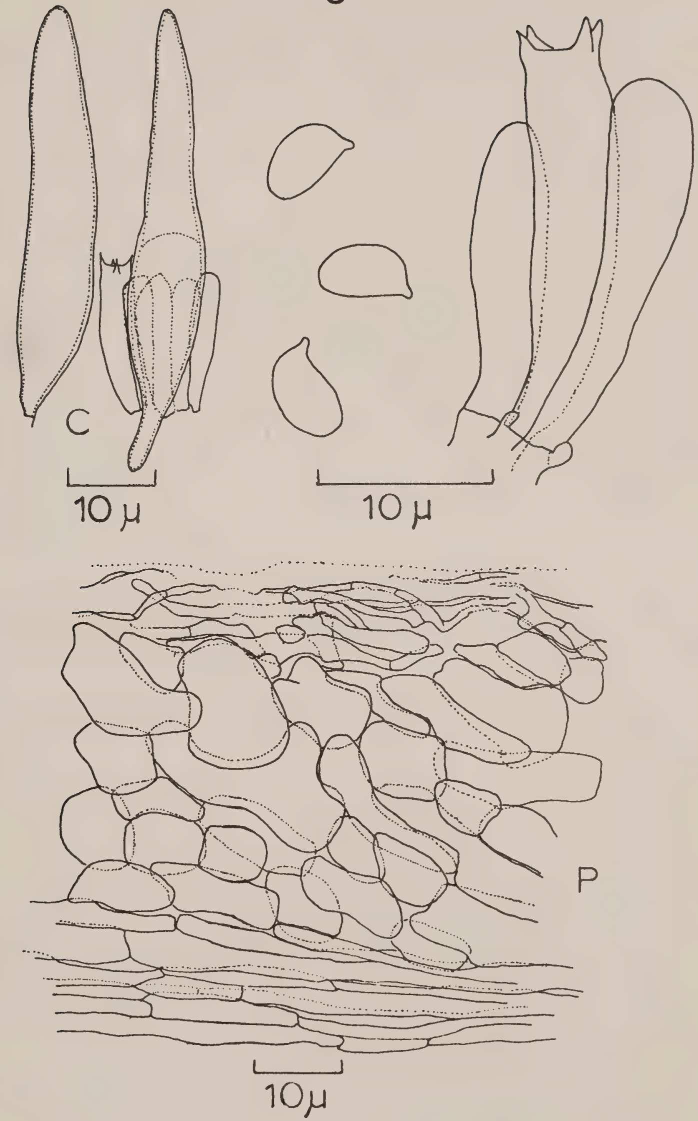
8. Caulorhiza umbonata (Peck) Lennox comb. nov.
Figure 8, Plate II.

Basionym: Collybia umbonata Peck. Torrey Botanical Club. Vol. 31(4):178. 1904.

PILEUS 4-8.7 cm broad, light tawny or tawny grey (6D8), darker at the center and at extreme margin (7F8), hygrophanous and drying lighter; broadly campanulate or conic, expanding to almost plane, with a sharp prominent umbo, margin at first even, later frequently frayed or split, irregularly plicate-striate for one third the radius; surface glabrous, dull-translucent when moist, sublubricous, moist-striate, drying matte; context somewhat thick, usually 2 mm over the disc, consistency rather soft and limp; odor faint, fungoid, taste none or musty.

LAMELLAE light ochraceous (4A3), narrowly adnexed, deeply sinuate, becoming emarginate, blunt-ended at the stipe, rounded towards the cap margin, broad all the way to the cap margin, thick, crowded, 80 lamellae reaching stipe, 40 x 9 mm, edge even and concolorous.

8


C
10 µ
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P
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Figure 8. - Caulorhiza umbonata, Peck type, basidium and spores, cheilocystidia (c); W122, pileal surface (p).

STIPE 4.5-23 cm long, 8-14 mm broad, paler than the cap, almost the shade of the gills, light tawny to buff (4A3 to 5B3), equal above ground, then tapering downward from ground level, surface even, faintly glaucous or powdery, glabrescent with age and handling, covered by adhering soil and duff particles in the lower half, very finely striate-grooved, dull-matte; hollow, terete or somewhat compressed, quite fibrous, slightly flexuous, with a distinct rind, pallid within, rooting deeply into the soil or duff, usually buried for at least half the length, without rhizomorphs or a sclerotium.

SPORES 5.5-7.0 x 3.0-3.5 µm, ovate to broadly ellipsoid, smooth, thin-walled, hyaline, amyloid, white in deposit; BASIDIA 23-27 x 4-5.5 µm, rather long and slender, noncarminophilous, often constricted slightly below the apex as basidioles, becoming more clavate at maturity, four-spored; no cheilocystidia differentiated; PLEUROCYSTIDIA scattered to abundant, clavate-inflated, often pedicellate and arising rather deep in the trama, thin-walled, nonencrusted, hyaline, 60-82 x 11-14 µm; PILEAL SURFACE a thin cutis of narrow, repent hyphae, giving rise to dermatopileocystidia, these scattered, often inconspicuous, clavate to subclavate, hyaline, thin-walled, 25-33 x 6-10 µm; the cutis subtended by a subcellular zone appearing more or less radial; CONTEXT of radially arranged, compact hyphae, nonamyloid and clamped; GILL TRAMA parallel to slightly bilateral, composed of rather narrow compact hyphae.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react positively with alpha-napthol, guaiacol, sulfoformol (faint, yellowish), phenol, phenol-aniline, and ferric sulfate.

HABITAT: Scattered under redwoods in very dense conifer woods; if present in Washington, probably introduced with its mycorrhizal partner.

MATERIAL STUDIED: CALIFORNIA, Marin Co., W611 (50 miles N. of San Francisco); Mendocino Co., W122 (15 miles N.W. of Willits, on Hwy. 20), W1338 (Woodlands Camp).

This species varies deceptively in color and somewhat in the robust character of cap and stipe. Sometimes it resembles Phaeocollybia kaufmannii rather closely, except for the gill color, and has a rather reddish dark fulvous coloring, robust stipe, and firm cap with a thick context. In other instances, it more closely resembles Oudemansiella radicata, which has a glycerine soap appearance on the cap, nonamyloid spores and abundant caulocystidia.

The habitat under redwoods, the long radicating stipe, presence of pleurocystidia, a complex pileal surface, and amyloid spores sets this species apart.

CLITOCYBULA (Singer) Metrod, Rev. Mycol. 17:74. 1952.

Synonyms: Fayodia subgenus Clitocybula Singer. Ann Mycol. 41:63. 1943.
Cantharellula subgenus Neocantharellula Singer. Sydowia 6:194. 1952.

Type species: Clitocybula laceratus (Scopoli per Pollini) Metrod.

HABIT collybioid to clitocyboid, PILEUS grey to tan, convex becoming plane, often centrally depressed or umbilicate, margin even or frayed, surface dry to lubricous, subglabrous to virgate-streaked with blackish fibrils, at least on the disc, generally not translucent-striate, subhygrophanous or unchanging; context thin, generally brittle, whitish; odor and taste not distinctive.

LAMELLAE generally adnate to subdecurrent, whitish to greyish, edge even or frayed, thin, usually rather close.

STIPE white to plae grey or tan, equal, generally rather slender, surface dull and clothed thinly with a powdery-pubescence, fibrous, often rather soft, not rooting and without rhizomorphs.

SPORES amyloid, smooth, globose or subglobose to ovate or ellipsoid, white in deposit; PILEOCYSTIDIA and CAULOCYSTIDIA present although frequently scant, cheilocystidia and pleurocystidia not differentiated; PILEAL SURFACE generally a cutis of radial, narrow, repent hyphae, the pileocystidia arising innately as the upturned and rounded ends of the surface hyphae, or cystidioid, context of larger diameter hyphae, freqnuently rather thick walled, clamped and nonamyloid.

MACROCHEMICAL REACTIONS: Data are available only on one of the species, which reacts with most of the reagents used.

HABITAT: The carpophores are lignicolous and associated either with hardwoods or conifers, sometimes both. They are frequently found in tight caespitose clusters, although one of the species is characterized by a gregarious habit.

Key to the Clitocybula Species

1. Cap smooth, subglabrous, not fibrillose, lubricous-moist, spores globose and 3.5-5 µm broad.. C. familia (p.158)
1. Cap innately radiate-fibrillose with blackish fibrils, at least on the disc, grey to fuscous, dry in all stages, spores ovate (4.5-8 µm long)....... 2.

2. Pileus medium sized, 3-6 cm generally at least 4 cm at maturity or a few carpophores in any one collection attaining this size, gills greyish, cap margin conspicuously lacerate, spores 6-8 x 4.5-5 µm.. C. lacerata (p. 159)
2. Pileus rather small, generally less than 4 cm in diameter, gills whitish, never really pale grey, cap margin sometimes frayed in older specimens, spores 4.5-6.5 x 3.5-5.0 µm............................ C. abundans (p. 161)

9. Clitocybula familia (Peck) Singer. Sydowia 15:53. 1961. Plate III.

Basionym: Agaricus familia Peck. Ann. Rep. N. Y. State Mus. 23:79. 1873.

Synonyms: Collybia familia (Peck) Sacc. Syll. Fung. 5:241. 1887.
Gymnopus familia (Peck) Murrill. N. Amer. Fl. 9:365. 1916.
Baeospora familia (Peck) Singer. Re. Mycol. 3:193. 1938.
Fayodia familia (Peck) Singer. Agar. Mod. Tax. p. 349. 1951.
Gymnopus denticulatus Merrill. N. Am. Fl. Vol. 9(5):368. 1916.

Illustrations: Singer, Sydowia 15:53. 1961 Figs. 2, 15, 16; Bigelow, Mycologia 65:1105. 1973.

PILEUS up to 4 cm broad, yellowish tan to honey colored (4A3 to 5D5), darkest at the center and intergrading with the margin, almost white in a narrow band on the margin, subhygrophanous and drying slightly lighter and more greyish, generally in a radially streaked fashion; convex or hemispheric, becoming plane, usually with a low broad umbo, margin at first strongly inrolled, remaining somewhat inrolled at maturity or becoming straight, even; surface regular, smooth, subglabrous, with a thin pruinosity under a lens, giving a slight frosted appearance, moist-lubricous, occasionally translucent-striate; context thin (1-2 mm on the edge of the disc), cartilaginous and brittle when moist, concolorous; odor faint, rather sweet, somewhat like tea, taste none or faintly fungoid.

LAMELLAE white, broadly adnate, then sharply sinuate and later nearly free, slightly uncinate, pointed both at the margin of the cap and the stipe, ventricose, very thin, close, 48-56 lamellae reaching the stipe, 3-4 tiers of lamellulae, rather broad, 12-16 x 3-4 mm, edge entire and concolorous.

STIPE 2.2-11 cm long, 2.0-5.0 mm broad, long relative to the cap size, narrow, pallid to pale greyish (4C3 or lighter), sometimes spotting faintly pale ferruginous, yellowing markedly on drying; markedly equal and strict for most of the length, occasionally with an undulate surface, often flared just at the apex; moist, powdery-evanescent like the cap, especially evident on drying, short strigose to appressed-tomentose in a narrow white band at the base; terete, hollow, cartilaginous, splitting easily longitudinally, concolorous within.

SPORES 3.5-5.5 x 3.5-4.5 µm, globose to subglobose, smooth, thin-walled, readily collapsing, hyaline, amyloid, white in deposit; BASIDIA 15-22 x 4.5-6 µm, four-spored; no pleurocystidia or cheilocystidia differentiated; PILEAL SURFACE a cutis of narrow (1-5 µm broad), repent, radially oriented hyphae in a zone about 10 um in depth, not encrusted; PILEOCYSTIDIA scattered on the disc, cylindrical or fusoid or clavate, 22.5-80 x 7.5-15 µm, hyaline and thin-walled; CONTEXT composed of radial hyphae of two distinct sizes, small hyphae of 5 um or less in diameter and larger inflated cylindrical thick-walled hyphae 3-10 µm broad, nonamyloid, clamped; GILL TRAMA parallel, of large diameter hyphae, 2-13 µm broad, averaging 7 µm, clamped, nonamyloid; CAULOCYSTIDIA fasciculate, subcylindrical or clavate or nearly bulbous, thin-walled, hyaline, 18-60 (100) x 2-12 µm, nonamyloid, not encrusted

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react with aniline (yellow to red), alpha-napthol, guaicaol, tincture of guaiac, sulfoformol (yellowish), phenol, and phenol-aniline (dark red to purple black).

HABITAT: Caespitose on logs and stumps of conifers.

MATERIAL STUDIED: WASHINGTON, Skagit Co., W1693 (Mineral Park Campground); King Co., W972, W1668 (Dalles Creek Campground); Pierce Co., W1703 (Tahoma Creek, Mt. Rainier Ntl. Pk.); NEW YORK, North Elba, Nov. 11, 1873 (C. H. Peck Type).

In general appearance and habit this species closely resembles *Collybia acervata*, but lacks the reddish colors and marked hygrophanous character of this latter species. *Clitocybula familia* can be most readily identified by its globose, amyloid, thin-walled spores, a character it shares with the genus *Baeospora*. Members of *Baeospora*, however, are smaller species with narrow, very crowded gills, tough-pliant tissues, and abundant cheilocystidia. *Clitocybula familia* is distinct from other members of the genus in lacking the characteristic blackish fibrils on the cap that give a radiate-streaked effect.

10. *Clitocybula lacerata* (Scop. per Pollini) Metrod. Rev. Mycol. 17:87. 1952. Plate III.

Basionym: *Agaricus laceratus* Scop. per Pollini, Fl.

Veronensis 3:636. 1824.
Synonyms: Collybia lacerata (Scop. per Pollini) Gillet, Les Hymenomycetes, p. 310. 1874.
Fayodia lacerata (Scop. per Pollini) Singer. Ann. Mycol. 34:331. 1936.
Collybia platyphylla ssp. lacerata (Scop. per Pollini) Konrad and Maublanc. Icones Selectae Fungorum, p. 242. 1939.

Illustration: Smith. Journ. Elisha Mitchell Sci. Soc: 56, 307. 1940. Plate 7; Bigelow, Mycologia 65:1973. fig. 1.

PILEUS 3-6 cm broad, dull watery grey (closest to "drab") when moist, translucent-striate or streaked with fuscous lines, hygrophanous, pallid ashy grey and opaque when faded; convex at first with an inrolled margin, expanding to broadly convex, disc soon depressed, margin very thin and soon lacerated or lobed and quite irregular; surface appressed radiate-fibrillose, at least near the disc, rimose at times, dull when moist; context very thin and fragile, pallid when faded; odor and taste not distinctive.

LAMELLAE broadly adnate to subdecurrent from a tooth, dull grey, distant to subdistant, broad, usually venose and at times anastomosed, very thin and easily broken, edges concolorous.

STIPE 1.5-5 cm long, 2-5 mm thick, concolorous with the cap or paler, dingy to pale grey, equal or tapering upward, often curved, surface faintly pruinose at first but soon naked and polished, moist, with a white cottony myceliod base; tubular, cartilaginous, terete when immature, soon deeply furrowed or compressed.

SPORES 6-8 x 4.5-5.5 µm, broadly ovate to ellipsoid, hyaline, smooth, amyloid, thin-walled, white in deposit; BASIDIA 25-40 x 5.5-7 (-9) µm, four-spored; no cheilocystidia or pleurocystidia differentiated; PILEAL SURFACE a thin cutis of cylindrical hyphae 3.5-7 µm in diameter, hyaline or pale fuliginous; PILEOCYSTIDIA present, at least on the disc, erect or recumbent, cylindric or clavate, 25.5-38 x 6-12.5 µm, pale fuliginous in KOH, pigment intracellular and in slightly thickened walls; CONTEXT hyaline, hyphae cylindrical or somewhat inflated (4) 10-25 µm in diameter, walls usually thickened (0.5-1.0 µm thick); GILL TRAMA of parallel hyphae, cylindric to somewhat inflated, (4) 12-23 µm in diameter, walls usually thickened, clamped, with scattered oleiferous hyphae (3 µm broad); CAULOCYSTIDIA rarely present, subclavate to clavate, hyaline, smooth 24-62 x 5-15 µm; STIPE HYPHAE mostly with thickened walls, cylindric or somewhat inflated. (Composite description drawn from Smith, 1940, and Bigelow, 1973).

MACROCHEMICAL REACTIONS: No data available.

HABITAT: Scattered to gregarious on logs or stumps of conifers or hardwoods (oak or birch).

MATERIAL STUDIED: MICHIGAN, Stuntz 8373 (Tahquamenon Falls).

Bigelow (1973) reports that this species has occurred in Idaho and it is probable that it exists in Washington, although rare. Perhaps it is frequently mistaken for a depauperate *Tricholoma* or a somewhat aberrant *Clitocybe*.

It is distinguished from *Clitocybula abundans*, to which it is mostly closely allied, by its much larger, more ovate to ellipsoid spores, larger size, and lacerate character of the cap and gills. In addition, it is rarely found in abundance or in the large caespitose clusters of the other species of the genus.

11. *Clitocybula abundans* (Peck) Singer. Sydowia 15:53. (1961). 1962.

Basionym: *Agaricus abundans* Peck. Ann. Rep. N. Y. State Mus. 29:38. 1878.
Synonyms: *Collybia abundans* (Peck) Sacc. Syll. Fung. 5:241. 1887.
Fayodia abundans (Peck) Singer. Lloydia 5:126. 1942.

Illustrations: Singer, Sydowia 15:53. 1962. figs. 5-8; Kauffman, Agar. of Mich., Vol II, Plate 166.

PILEUS up to 4 cm, generally about 2 cm broad; greyish tan to light fuscous (4A3), darker fuscous on the disc (4E4), subhygrophanous and drying somewhat lighter; convex to hemispheric, becoming plane, depressed with age, margin inrolled strongly at first, remaining curved or arched at maturity, often splitting; surface moist or dry, innately radiate-fibrillose or disc densely fibrillose, only slightly or not at all translucent-striate; context thin, firm but not tough, whitish; taste and odor not distinctive.

LAMELLAE broadly adnate to subdecurrent as the margin of the cap is raised, white, rather narrow, thin, with close to normal spacing, blunt-ended both at the stipe and margin, edges even and concolorous, not fraying.

STIPE up to 5 cm long, apex to 5 mm, relatively short, whitish, evenly colored top to bottom, unchanging, equal or slightly flared at the base, generally flexuous, terete, hollow, surface with a thin whitish pubescence or only pruinose at the apex.

SPORES 4.5-6 (6.5) x 3.5-5.5 µm, subglobose to ovate, smooth, hyaline, thin-walled and collapsing readily in crush mounts, amyloid; BASIDIA 19-27 x 4-7 µm four-spored; CHEILOCYSTIDIA basidioid to subsaccate, 33-50 x 7-16 µm, smooth, hyaline, thin-walled, scattered and inconspicuous; pleurocystida not differentiated; PILEAL SURFACE a cutis of narrow (2-4 µm broad) compact hyphae, intergrading with the hyphae of the context in size and wall thickness; CONTEXT of inflated cylindrical hyphae, 2-14 µm in diameter, walls usually thickened (up to 1 µm), clamped, nonamyloid; PILEOCYSTIDIA present, more abundant on the disc, scattered elsewhere, 40-60 x 6-12 µm, broad, cylindrical to clavate, walls somewhat thickened or thin, hyaline, not encrusted; GILL TRAMA parallel, composed of large inflated hyphae (2-17 µm in diameter), nonamyloid, clamped, oleiferous hyphae present, 3-9 µm broad; CAULOCYSTIDIA subclavate to clavate-bulbous, 40-50 x 3.5(7)-13 µm, hyaline, thin-walled, scattered or in groups; STIPE CORTEX with both thin and thick-walled cells. (Description drawn in part from that of Bigelow, 1973.)

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react positively with aniline (faint, yellowish), phenol, and phenol-aniline.

HABITAT: Caespitose on logs or stumps of conifers.

MATERIAL STUDIED: WASHINGTON, Clallam or Jefferson Co., C. H. Kauffman, Oct. 7, 1915 (Olympic Mts.); Pierce Co., Smith 47824 (Lower Tahoma Cr., Rainier Ntl. Pk.); MICHIGAN, Smith 33510 (Upper Tahquamenon Falls); W842, (Oakland Co., Haven Hill Lk.); NEW YORK, Peck, Grieg, Lewis Co., Sept.

BAEOSPORA Singer. Rev. Mycol. 3:193. 1938.

Synonyms: *Collybia* pro parte Kummer. Führ. Pilzk. p. 26. 1881

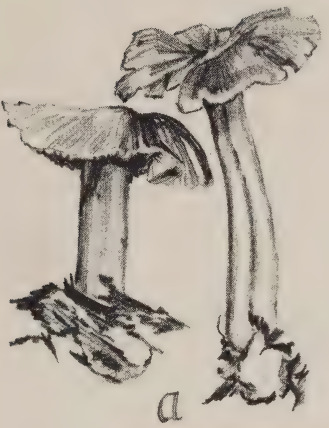
Type species: *Baeospora myosura* (Fr. ex Fr.) Singer.

PILEUS generally small, collybioid, tan to buff, sometimes with a violet tinge, convex becoming plane, sometimes almost conic; surface glabrous to floccose, even, regular; margin inrolled and even, context thin, concolorous, tough, pliant; smell and taste not distinctive.

LAMELLAE pallid to violet, sinuate to almost free, narrow, thin, crowded, linear, spore print white.

PLATE III -; a - *Clitocybula lacerata*, after Smith in Bigelow, 1973, x1; b - *Clitocybula familia*, W1693, x 1½; c - *Baeospora myosura*, W910a, x 2; d - *Baeospora myriodophylla*, W1644, x 1.

III



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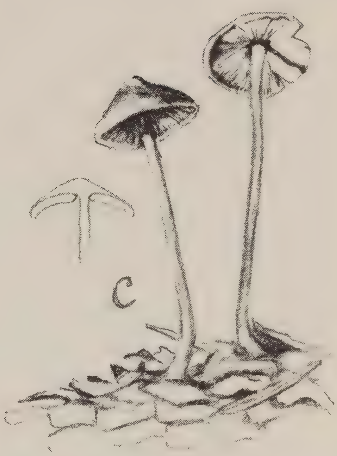

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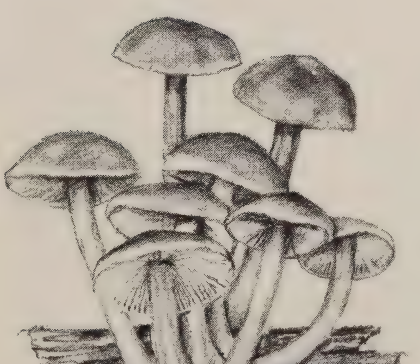

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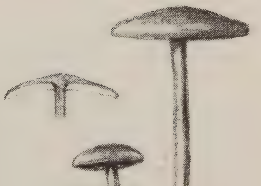


d

STIPE concolorous with the cap or nearly so, relatively long and narrow in relation to the size of the cap, surface floccose, almost glabrous in older specimens; equal, terete, hollow, rather tough and pliant, strigose or tomentose at the base and then white, at times partially rooting.

SPORES small, not exceeding 5 µm in length, ovate to short-cylindric, thin-walled, amyloid, hyaline; BASIDIA very small and cylindric, four-spored; GILL TRAMA of large diameter hyphae, clamped, interwoven, appearing subparallel in tangential section, nonamyloid; CHEILOCYSTIDIA abundant, gill edge hetermorphous, clavate-pointed, ventricose, pedicellate or not, thin-walled and hyaline, sometimes encrusted with an amorphous dextrinoid substance; PLEUROCYSTIDIA scattered, most abundant toward the gill edge, with the same characters as the cheilocystidia; PILEAL SURFACE a cutis with a subcellular hypoderm, encrusted or not, with pileocystidia scattered to rare, grouped, clavate to subfusiform; STIPE composed of longitudinal encrusted hyphae overlain by groups of caulocystidia, these abundant and forming clusters, thin-walled, hyaline, clavate-rostrate, ventricose, and sometimes pedicellate.

HABITAT: on cones or wood, solitary to gregarious.

MACROCHEMICAL REACTIONS: Gills and flesh react faintly with guaiacol and ferric sulfate in one of the species.

This is an easily characterized and natural grouping: The cap is thin-fleshed and quite tough, the gills are very narrow, thin, and crowded, the stipe is rather slender and floccose, the spores minute and amyloid, pileal surface a cutis with subcellular hypoderm, and the gill edge is hetermorphous with cheilocystidia. Superficially, the genus appears to be very close to _Strobilurus_, however, it is quite distinct from a microscopic viewpoint: _Baeospora_ has amyloid spores and clamped hyphae, and lacks the hymeniform pileal surface as well as the distinctive subcapitate cystidia. Probably, more often the genus will be confused with a _Marasmius_ as the general aspect and consistency are like a species of that genus. The combination of narrow, very crowded gills, small amyloid spores, nonamyloid tissue, and a subcellular hypoderm underlying the cutis, however, makes placement of these species into _Marasmius_ difficult.

Key to _Baeospora_ Species

1. Pileus light tan, gills white, on buried cones.... .... _B. myosura_
1. Pileus fulvous with a strong violaceous tone toward the margin, gills purple, on wood................ .... _B. myriodophylla_

12. Baeospora myosura (Fr.) Singer.

Figure 9, Plate III.

Basionym: Agaricus myosurus Fries. System. Mycol. Vol I:132. 1821.
Synonyms: Collybia myosura (Fries) Quélet. Champ. Jura Vosges. ser II, 5:95. 1872.

PILEUS 0.8-2.5 cm, warm buff to honey brown when moist (5E4 to 5D4), drying somewhat lighter, especially at the margin (5C4 to 5B3), subhygrophanous; convex to subconic becoming plane, occasionally shallowly umbonate, margin remaining inrolled, sometimes straight; surface over the disc almost glabrous, powdery elsewhere and appearing thinly pruinose on the margin, context thin, concolorous or pallid, tough-pliant, reviving; odor and taste not distinctive.

LAMELLAE pallid to light pinkish buff (4A2 to 5C3), thin, very narrow and crowded, linear, blunt-pointed both toward the stipe and margin, edge even and concolorous, sharply sinuate, appearing almost free, 3 tiers.

STIPE 2.5-4.2 cm. x 10-1.5 mm, concolorous at the apex, then darkening slightly, and dark buff for most of its length (5C5 at apex to 5D5), subhygrophanous, drying slightly lighter; equal or slightly tapered toward base in the upper half; surface finely pruinose to irregularily powdery, appearing almost glabrous when moist, the surface coating much more visible in drying, strigose at the base where attached to substratum, frequently with white rhizomorphs as well; flesh tough-pliant, solid to stuffed, and concolorous.

SPORES 3-5 x 2-3 µm, short-ovate to cylindrical, thin-walled, hyaline, amyloid, white in deposit; BASIDIA very small, cylindrical, 16-19 x 3.5-4 µm, four-spored, without encrustation; CHEILOCYSTIDIA very abundant, 15-24 x 4-8 µm, rather small, making the gill edge heterogeneous, broadly clavate, much wider in the lower half and tapering to an obtuse apex, thin-walled and hyaline; PLEUROCYSTIDIA similar to the cheilocystidia, most abundant toward the gill edge, scattered elsewhere; GILL TRAMA interwoven, appearing subparallel in tangential section, composed of hyphae 4-13 µm in diameter, clamped and nonamyloid, subhymenium narrow, compact and interwoven; PILEAL SURFACE a cutis of rather coarse hyphae, 3-5 µm in diameter, scarcely encrusted, in a shallow zone 7-10 µm deep, subtended by a conspicuous subcellular hypoderm; STIPE surface somewhat encrusted, covered rather densely with dermatocaulocystidia, longer and more tapered than those of the gill edge, ventricose, clavate and tapering most of the length to an obtuse apex, thin-walled, hyaline, and clustered, 18-55 x 5-9 µm.

HABITAT: Solitary to gregarious on cones of Douglas

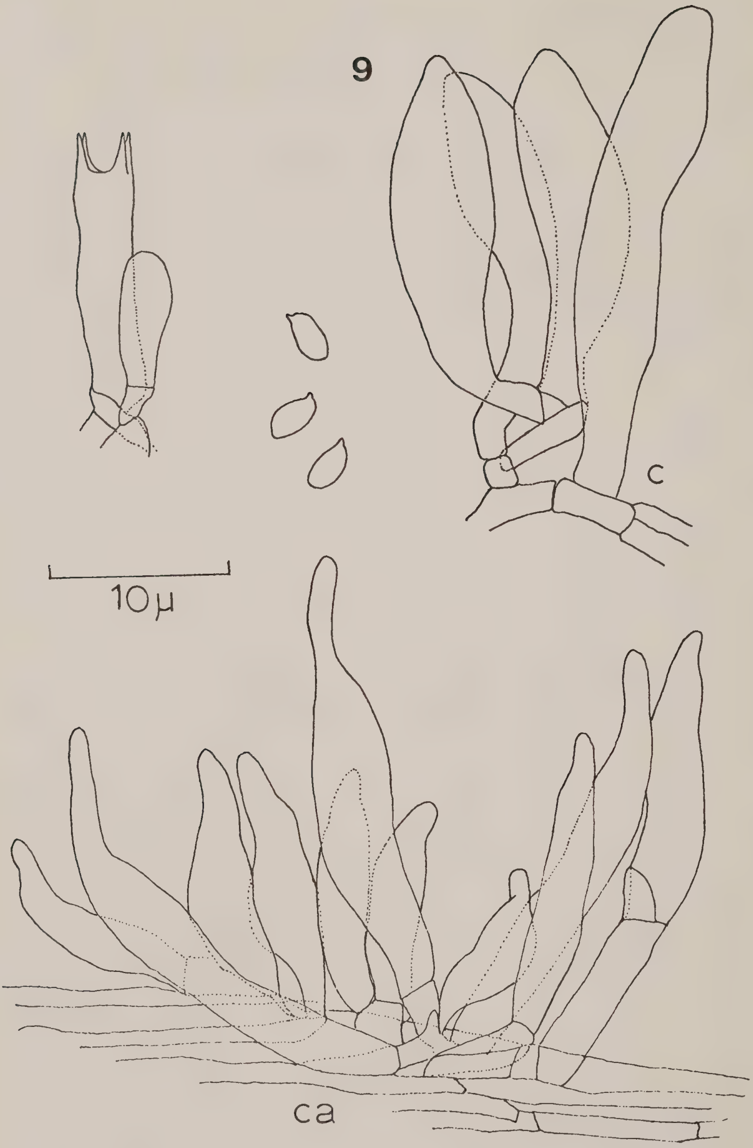


Figure 9. - Baeospora myosura, W1186, basidium, spores, caulocystidia (ca), cheilocystidia (c).

fir or spruce, these often buried.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react faintly and sporadically with alpha-napthol, guaiacol, and ferric sulfate.

MATERIAL STUDIED: WASHINGTON, San Juan Co., W1741 (Friday Harbor Biological Station); Clallam Co., W1007 (Deep Cr.); Grays Harbor Co., W1013 (Copalis); Thurston Co., W1012 (Summit Lake); Snohomish Co. W1169 (Thunderbird Campground); King Co., W1019, W1061 (University of Washington), W1166, W1186 (Water Main Woods); Pierce Co., W1218 (Ipsut Cr. - Mt. Rainier Ntl. Pk.); IDAHO, Bonner Co., W910A (Collin Swamp), W964 (Bindarch Cr.); CALIFORNIA, Mendocino Co., W1347 (Woodlands Camp).

This species may be synonymous with _Baeospora conigena_ (Fr.) Lange or at least very close to it. The main distinctions between the two species according to Fries and Ricken are a long glabrous radicating stipe and white floccose vesture on the stipe and cap of _Baeospora myosura_ (Fr.) Singer. The _Baeospora_ of this region, here described as _B. myosura_, does have a fine powdery covering on the stipe and to some extent on the cap, and the stipe is sometimes radicating especially in the cases where specimens are encountered on buried cones, but the base is often rather heavily strigose and provided with white rhizomorphs. Since Ricken considers the glabrous stipe base as a diagnostic feature of _B. myosura_, it seemed best to place the present species there. Further definition of these two closely related species, is dependent on the possibility of an unexamined extant Persoon type, as _B. conigena_ is a pre-Fresian species described by Persoon.

13. _Baespora myriodophylla_ (Peck) Singer. Rev. Mycol. 3:193. 1938.

Figure 10, Plate III.

Basionym: _Agaricus myriodophyllus_ Peck. N. Y. State Mus. Rep. 25:75. 1873.
Synonyms: _Collybia myriodophylla_ (Peck) Sacc. Syll. Fung. 5:236. 1887.
Collybia lilacea Quélet. Champ. Jur. Vosges. III:434. 1875.
Mycena myriodophylla (Peck) Kühner. Le Genre _Mycena_: 528. 1938.
Collybia teleoianthina Métrod. Rev. Mycol. II:163. 1937.

Illustrations: Hard, Mushrooms, p. 115, fig. 85; Quélet, Champ. Vosges 3, tab. 1, fig. 1.

PILEUS 1.5-2.5 cm., convex and then plane, sometimes shallowly umbilicate or mammillate, dark warm brown (6F6) when moist, hygrophanous and drying much lighter, honey

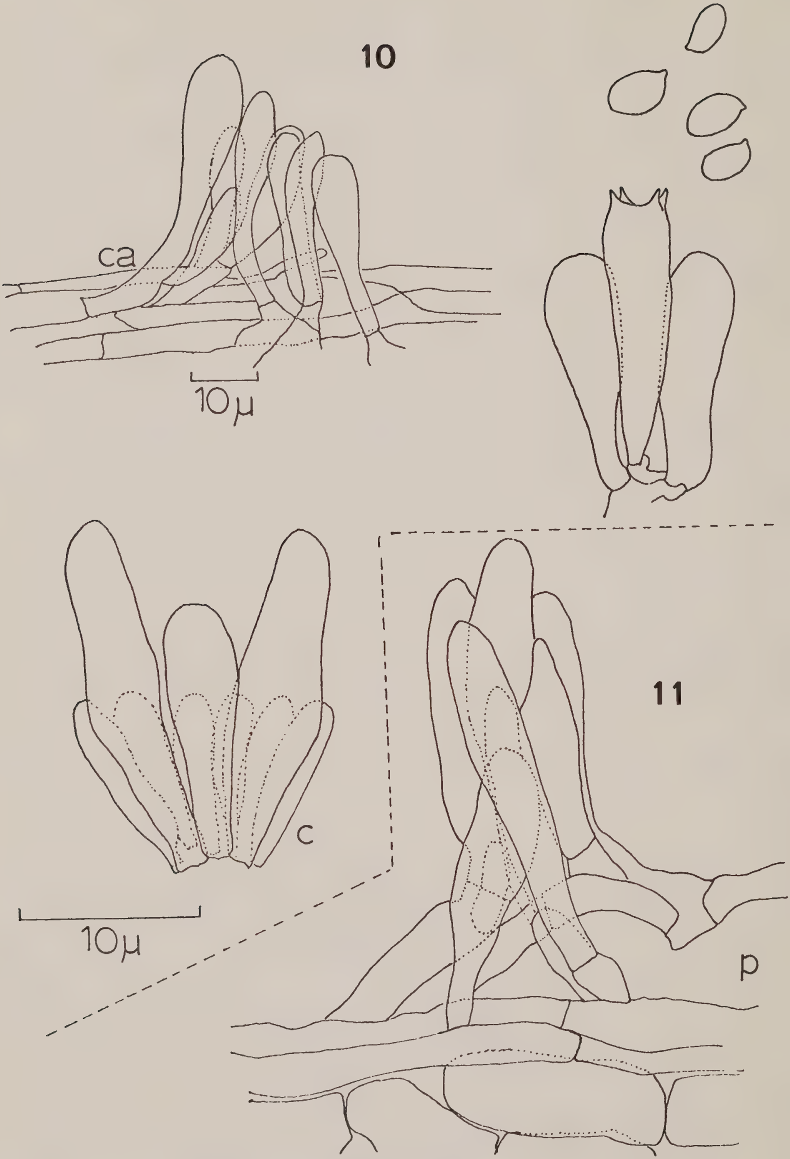


Figure 10. - Baeospora myriodophylla, W1702, basidium, spores, caulocystidia (ca), cheilocystidia (c); Figure 11. - Baeospora myosura, W1186, pileal surface and pileocystidia (p).

brown (6D6), generally with a purplish tinge toward the margin when moist; surface dull, minutely rugose, faintly floccose, especially toward the margin, margin even and remaining somewhat inrolled, context very thin, pale lilac when moist, the pallid, tough-pliant, more brittle in drying; taste and odor faint and fungoid.

LAMELLAE brick to dark purple (14E3 to 14F4), drying darker and with a fuscous tone, adnate to uncinate, linear, narrow, very thin and crowded, edge even and concolorous.

STIPE 2.5-5.5 cm long, 1-2.5 mm in diameter; lilac at the apex (15F3 or 15F2), becoming brown to reddish brown downward or in drying, equal most of length, usually somewhat expanded at base and apex; pruinose for the entire length, densely so at the base, then almost matted, darker under the covering, lighter in drying specimens; terete or compressed-furrowed, hollow, stuffed; tough, fibrous, not pliant.

SPORES minute, 2.5-4.0 x (1.5) 2-3 µm, amyloid, thin-walled, ovate to almost ellipsoid, smooth, white in deposit; BASIDIA small, 14-15 x 3-4.5 µm, four-spored, cylindrical, heavily encursted with a weakly dextrinoid amorphous substance, seeming to cement the cells together at the base; CHEILOCYSTIDIA abundant, clavate, ventricose, apex obtuse and nipple-like or broadly rounded, thin-walled, hyaline, relatively small, 18-28 x 3-7 µm; PLEUROCYSTIDIA as above but scattered, more abundant toward the gill edge; CAULOCYSTIDIA somewhat longer, broader, and more variable in shape than those of the gill edge. hyaline, thin-walled, sometimes with granular contents, strongly grouped, 12-30 x 5-9 µm, SUBHYMENIUM narrow and compact, interwoven; TRAMA parallel or slightly interwoven, composed of large diameter hyphae, 4-20 µm, thin-walled, nonamyloid, and clamped; PILEAL SURFACE a narrow cutis of agglutinated slender hyphae, 1-2 µm in diameter, in a zone 5-10 um deep, differing markedly from the underlying tissue; CONTEXT of larger diameter hyphae, 10-15 µm, the upper strata appearing like a subcellular hypoderm in tangential section, broadly rectangular in radial view, slightly encrusted in a banded pattern.

HABITAT: Scattered to caespitose on much decayed wood in moist lowland mixed woods, spring or fall.

MACROCHEMICAL REACTIONS: All reactions were negative.

MATERIAL STUDIED: WASHINGTON, Kittitas Co., W1644 (Crystal Springs); W1749 (Easton); Jefferson Co., W517 (Enchanted Valley); Pierce Co., W1702 (Mt. Rainier Ntl. Pk. - Tahoma Cr.) Stz 7564 (Mt. Rainier Ntl. Pk. - Green Lk.); NEW YORK, Peck type (Portville).

This is a very distinct species, which because of its unusual lilac tones and microscopic features could hardly be confused with any other species of its stature. Some confusion may result from the collection of partially dried specimens as the characteristic purplish colors are lost soon in drying; however, the small amyloid spores and abundant cheilocystidia will remain to set it apart.

FLAMMULINA Karst. Symb. Mycol. Fenn. 30, Meddlel. Soc. Faun. Fl. Fenn. 18:62. 1891.

Synonyms: Collybia pro parte Quél. Champ. Jura Vosges:59. 1872.
Collybidium Earle, Bull. N. Y. Bot. Gard. 5:428. 1909.
Myxocollybia Singer. Heih. Bot. Centralb., Abt. B 56:162. 1936.

Type species: Flammulina velutipes (Curt ex Fr.) Karst.

Habit collybioid, pileus viscid, with pileocystidia; lamellae usually yellowish, rounded-adnexed or adnate-sinuate, moderately thin; spore print white; spores hyaline, smooth, nonamyloid; basidia normal; cystidia present on the sides of the gills; context of the pileus fleshy; hyphae clamped and nonamyloid, lignicolous on hardwoods.

The genus is monotypic; for a more complete description see the species description which follows.

14. Flammulina velutipes (Curt. ex Fr.) Karst. Symb. Mycol. Fenn. 30, Meddlel. Soc. Faun. Fl. Fenn. 18:62. 1891. Figure 12, Plate IV.

Illustrations: Curtis, W.; Fl. Londin. 4. tab. 70; Britz. Hymenon., tab. 16, fig. 219; Gillet, Champ. Fr. Hymenon. tab. 238; Cooke, Illustr. Brit. Fungi. tab. 650; Peck, Edible Fungi, tab. 7.

PILEUS 1.7-5 cm, brownish yellow to dark warm brown (4A5 to 5C7), color may vary considerably from collection to collection, generally bright yellowish toward the margin and darker, reddish-brown on the disk, intergrading uniformly, spotting or staining dark brown (6F6); convex and then plane, margin remaining inrolled, often wavy and irregular, occasionally frayed; surface glabrous, viscid and shining, dull quickly in drying, the pellicle easily peeled from the cap, translucent-striate half to three-quarters the radius; context thin to moderately thick, yellow to dark brown just below the surface, firm, almost tough; smell and taste none.

LAMELLAE off white to yellow (5B4), emarginate to sinuate, edges even and concolorous, sharp-pointed at the margin, blunt toward the stipe, ventricose, broad, 9 x 3.5 mm, subdistant to close, up to 40 lamellae reaching stipe.

12

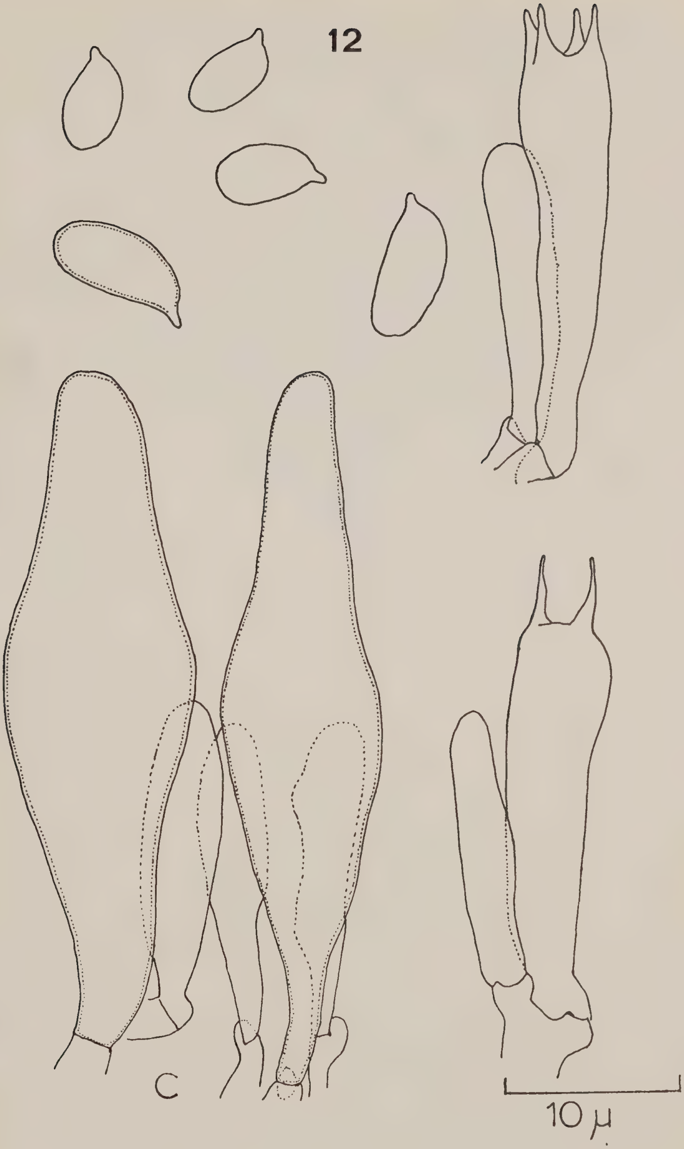


Figure 12. - Flammulina velutipes, W1688, basidia and spores, cheilocystidia (c).

STIPE 2.5-10.5 cm x 2-5 (12) mm, yellow at the apex, soon a dark yellowish brown and then a dark fulvous brown (4A4 to 5B4 to 6F4), equal and confluent at the base and appearing somewhat expanded there, terete or more often compressed and furrowed; surface densely covered with short dark fulvous hairs its entire length, dull, somewhat spotted with a darker brown tone, brown rhizomorphs at the base; hollow, with a dark brown outer rind, yellow within.

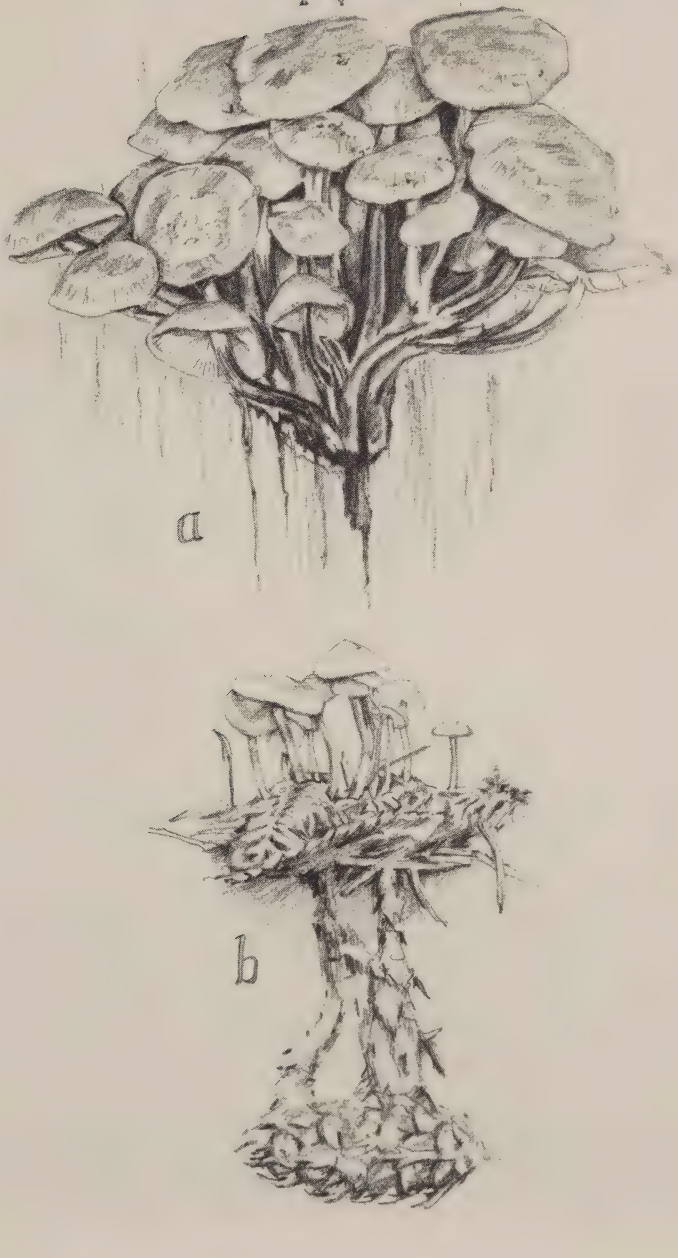
SPORES frequently in two sizes, 6.5-7.5 x 3-4 µm and 7.5-9 x 3.5-4 µm, cylindrical-ellipsoid to almost pip-shaped, smooth, generally with a somewhat thickened wall, nonamyloid; spore print pale yellow (3A2 - A3) in deposit; BASIDIA 16-24 x 4-6 µm, very elongate, shape variable, tapering gradually downward or abruptly enlarged in upper half; two-spored or four-spored mixed, or entirely four-spored, then lacking the longer, cylindrical to pip-shaped spores, nonamyloid, thin-walled; CHEILOCYSTIDIA 26-57 x 9-14 µm, abundance extremely variable, sometimes so numerour as to exclude basidioles on the gill edge, occasionally so rare as to be absent from any one crush mount, ventricose, quite large in diameter and generally widest in the lower half, often pedicellate, tapering gradually upward to an obtuse broad apex, thin-walled, arising rather shallowly from the subhymenium; frequently mixed with filamentous outgrowths from the trama, the presence and abundance of the latter being variable as well, generally equal, with a straight outline, sometimes contorted; PLEUROCYSTIDIA not differentiated; GILL TRAMA parallel and very regular to almost interwoven, of hyphae 3-10 (16) µm in diameter, nonamyloid, with very large keyhole clamps; SUBHYMENIUM narrow, compact and interwoven; PILEAL SURFACE a viscid layer of upright, partially gelatinized dermatocystidia, these clavate to filamentous, often irregular and largest in upper half, in a zone 32-65 µm in depth; PILEAL CONTEXT interwoven to nearly radially oriented, clamped, nonamyloid; STIPE TOMENTUM composed of long, dark brown, rather thick-walled, tangled hairs, of uniform diameter (3-4 µm); hyphae of the stipe encrusted in an irregular manner, clamped, and rather broad (5-12 µm in diameter).

HABITAT: Caespitose on deciduous wood, often on stumps, spring or fall, in the cooler part of the collecting seasons. It may occasionally be a mild wound parasite.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react positively with sulfoformol (yellow), phenol-aniline (faint-greenish), and ferric sulfate (yellowish to green); reaction to phenol is spotty.

PLATE IV -; a - Flammulina velutipes, W1443, x 3/4; b - Strobilurus trullisatus, W978, x 3/4.

IV



MATERIAL STUDIED: WASHINGTON, Chelan Co., W632 (E. of Stevens Pass); King Co., W607 (Seattle), W1688 (Water Main Woods), W90 (Betty's Bog); Skammania Co., W1443 (Cispus Camp).

This is a very striking collybioid fungus which remains quite distinct from other similar species and genera; its affinity is difficult to define. The densely short brown tomentose stipe, lignicolous habit, viscid dermatocystidia in a hymenium on the cap surface, and nonamyloid cylindrical spores which are a pale yellow in deposit, make an unusual set of characters that finds no counterpart in any other species.

There exists, however, within the framework of this well-defined genus, a great deal of variation. Collections vary strikingly in color, stature, general texture, staining reactions, degree and color of the stipe tomentum, and substratum. These macroscopic differences are matched by a bewildering variation in microscopic characters: spore size and shape, abundance of cystidia, presence of filamentous cystidia-like outgrowths of the trama on the gill edge, and a context that may range from being uniform and parallel to one that is interwoven and "knotty" in appearance. It may well be that there are more than one species or variety in the genus, but in the collections that I examined, I was unable to find any correlations in the data between macroscopic and microscopic variations.

STROBILURUS Singer. Persoonia 2:407-415. 1962.

Synonyms: Collybia pro parte. Kummer. Führ. Pilzk. p. 26. 1881.
Mycena pro parte S. F. Gray. Nat. Arr. Brit. Pl. 1:619. 1821.
Pseudohiatula pro parte. (Singer) Singer. in Notula syst. sect. crypt. Inst. bot. Acad. Sci. U.S.S.R. 4(10-12):8. 1938.

Type species: Strobilurus conigenoides (Ellis) Singer.

HABIT collybioid or marasmioid; PILEUS convex and then plane, margin remaining somewhat inrolled and entire, very rarely and not strikingly depressed or umbonate, white to very pale pinkish to smoky tan, surface very even, dull and unpolished, finely pubescent under a lens, margin translucent-striate when moist, subhygrophanous and not changing color; flesh thin and membranous, concolorous, tough, not reviving; smell and taste not distinctive.

LAMELLAE white, sometimes tinged yellowish or grey with age and dryness, close, narrow, thin and crowded, sinuate or rounded and then adnate, somewhat ventricose, sharp-pointed towards the margin of the pileus, edge even but pruinose from cystidia; spore print white.

STIPE generally very long relative to the cap size, pallid yellow to almost white at the apex and becoming increasingly yellow downward, yellow-tawny entire lower half; equal or seeming to expand gently downward; the surface unpolished and finely pubescent at the apex, not pruinose-powdery, becoming increasingly tomentose toward the base, often rooting to at least one half the length, and then densely wooly-tomentose and adherent to particles of the substratum; solid, tough and pliant.

SPORES ellipsoidal and generally less than 7 x 3.5 µm, smooth, thin-walled, nonamyloid; BASIDIA rather narrow and long relative to their size, about 20-22 x 5 µm average, four-spored or two-spored, noncarminophilous; GILL TRAMA subparallel; CHEILOCYSTIDIA numerous, ventricose and subacute to almost cylindrical, often subcapitate; PLEUROCYSTIDIA often the same as the cheilocystidia, or shorter, more subcapitate and cylindrical, frequently with the outer wall of the tip dissolved and capped with slime, rarely crystalline-encrusted; PILEOCYSTIDIA numerous to scattered, ventricose at the base and pedicellate and buried below, tapering and narrowly subcapitate above, rather thin-walled, and yellowish or hyaline; CAULOCYSTIDIA resembling the pileocystidia above the base, base is usually truncate, with a thin-wall, or occasionally with a yellow, thick wall, tapering to the apex and then subcapitate to rounded, not really ventricose at the base, contents hyaline or yellow; NO CLAMPS; PILEAL SURFACE a palisade of clavate to saccate-pedicellate cells, thin-walled and collapsing frequently in section, with hyaline or yellowish contents; context of pileus interwoven, of rather narrow hyphae 3-5 µm in diameter, yellow in Melzer's.

HABITAT: Solitary to caespitose on wood or cones of Douglas fir, pine, or spruce; generally in dense conifer woods.

MACROCHEMICAL REACTIONS: Gills and the flesh of the cap do not react with aniline, alpha-napthol, guaiacol, tincture of guaiac, formol, sulfoformol, phenol, phenol-aniline, and ferric sulfate.

The presence of subcapitate to cylindrical cystidia on cap, stipe, gill face and edge; the small thin-walled ellipsoid spores; the absence of clamp connections, the habit on wood and cones, the pseudorrhiza covered with a thick ochraceous tomentum, the rather tough-pliant consistency of the cap and stipe, and the non-reactive character of the flesh, set Strobilurus aside from its relatives in Collybia, Marasmius, and Mycena.

Although the above-mentioned characters seem to set Strobilurus aside from other genera, the delimitation of the species within the genus appears more difficult. This is true despite the fact that there are a large number of microscopic characters obtainable from the dried material.

The characters which have been used generally to separate the species are as follows: the shape and size of the cystidia, in particular, whether they are alike in shape on all parts of the carpophore, whether they are acute or obtuse, and whether or not they are thick-walled (2 µm); length of the pileocystidia, size of spore, color of cap, and type of substratum. These characters have been used most recently by Kempton and Wells (1971) in their treatment of *Strobilurus* in Alaska, and all three of the species that they found in Alaska were described as new. In working over my own material, I found that certain characters seemed correlated with other characters in a particular setting, but were variable and indistinct in other settings. For instance, a *Strobilurus* that is found in deep, dark, and mossy conifer woods, which has a rather large and dark smoky cap, and is attached to wood seems to fit *Strobilurus lignitilis* nicely. Likewise, a smaller form with a white to pale pink cap, found growing on Douglas fir cones in dense conifer forests with needle-litter floor matches *Strobilurus trullisatus*. There are however a distressing number of collections which fit neither of the two species well; and where cap color, habitat and substatum, and the microscopic features vary and intergrade with one another. The present treatment retains for the most part the delimitation of the species that Wells and Kempton proposed, and the species descriptions follow their own. Much more microscopic data needs to be accumulated from a wider geographic base, and a variety of different habitats and substrata. Examination of the Wells and Kempton types as well as those in Europe should help greatly in delimiting the species of this genus.

Key to the *Strobilurus* Species

1. Spores 3-4 x 1.5 - 3.0 µm, pileus white to pinkish, on cones of *Pseudotsuga menziesii*.................... .... *Strobilurus trullisatus* (p. 179)

1. Spore larger, pileus pinkish or greyish brown, on cones of other conifers or wood.................. 2.

    2. Pileocystidia 75-120 x 7.5-15 µm, pileus greyish brown, on buried decaying wood............... .... *Strobilurus lignitilis* (p. 180)

    2. Pileocystidia 30-70 x 5-11 µm, pileus greyish brown or rarely pinkish white, on cones of spruce or pine, rarely on buried wood............... 3.

3. Cheilocystidia and pleurocystidia nearly equal and shaped alike, with a ventricose base and tapering markedly to a subacute to subcapitate apex, on cones of *Picea*, rarely on buried wood.................. .... *Strobilurus occidentalis* (p. 182)

3. Cheilocystidia as above, pleurocystidia shorter, generally subcylindrical, and rounded to subcapitate at the apex, never subacute, on cones of *Pinus*......... .... *Strobilurus albipilatus* (p. 183)

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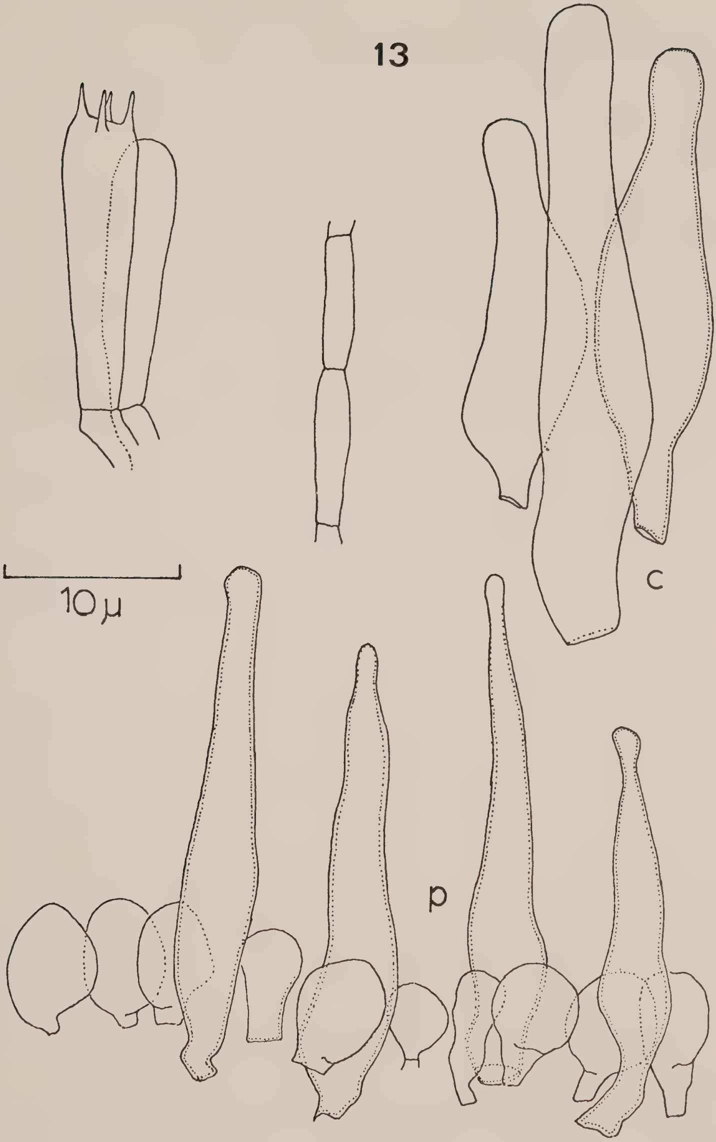

Figure 13. - Strobilurus trullisatus, Murrill type, basidium, hyphae, cheilocystidia (c), hymeniform elements of pileal surface and pileocystidia (p).

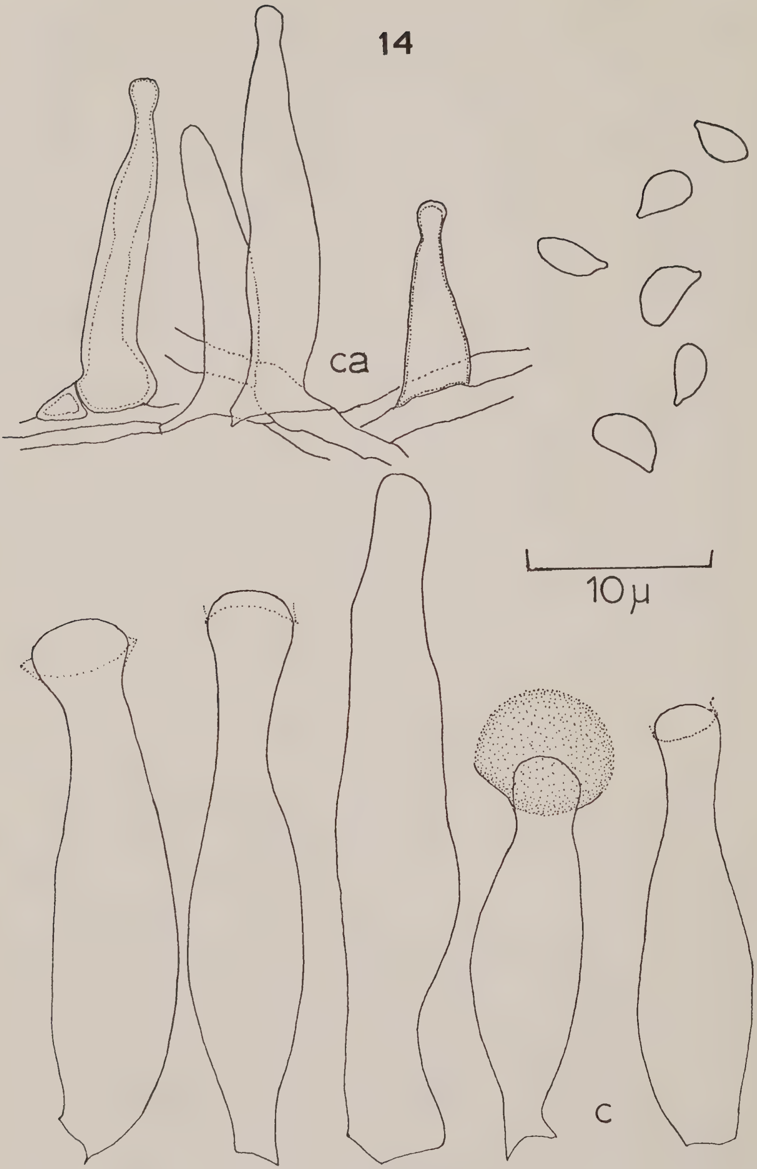

Figure 14. - Strobilurus trullisatus, Murrill type, caulocystidia (ca), cheilocystidia (c).

15. Strobilurus trullisatus (Murr.) Lennox comb nov.
Figures 13 and 14, Plate IV.

Basionym: Gymnopus trullisatus Murrill. N. Amer. Fl. 9 (pt. 5):367. 1916.
Synonyms: Collybia trullisata (Murr.) Murr., Mycol. 8:219. 1916.

PILEUS 5-13 mm broad, convex and becoming plane, not centrally depressed, sometimes umbonate, margin becoming straight or rarely somewhat revolute; white or pinkish centrally and with age, subhygrophanous and often greying or yellowing in drying, surface uniform, dull, almost bloom-like, finely pubescent under a lens, flesh thin, rather tough-pliant, and concolorous; taste and odor not distinctive.

LAMELLAE white, sometimes tinged yellowish in drying, broadly adnate to sinuate, and then subventricose, rather narrow, thin and crowded, 6 x 1 mm, edges even and pubescent.

STIPE 1.5-4.5 cm x 1-1.5 mm, white at the apex, becoming rapidly ochraceous to tawny below (5C6); equal and terete; surface unpolished, like etched glass, finely pubescent under a lens at the apex, wooly-tomentose with long, rather matted ochraceous mycelium where rooting and for about half the aerial length; rooting and with a pseudorrhiza generally equal to or greater than the aerial portion, tough-pliant.

SPORES 3-4.5 x 1.5-3.0 µm, smooth, hyaline, ellipsoid, thin-walled and nonamyloid; BASIDIA 20-26 x 3.5-5 µm, quite narrow, with conspicuous long sterigma, four-spored; GILL TRAMA of interwoven to subparallel hyphae 3.5-7.5 µm in diameter, pileal context of interwoven hyphae, nonamyloid and without clamps; CHEILOCYSTIDIA and PLEUROCYSTIDIA abundant (less so on the face), and similar, sybcylindrical to subventricose with a tapering tip, apex obtuse to subcapitate, hyaline to yellowish, frequently capped with a crown of slime, the outer wall of the apex dissolving and leaving a collarette below the slime head, rarely crystalline-encrusted, thin-walled or moderately thick (to 2 µm); PILEOCYSTIDIA rather abundant, 42-85 x 7.4-11.5 µm, ventricose-rostrate with obtuse to subcapitate apices, hyaline to yellowish, mostly thin-walled but some up to 2 um thick at the base, smooth or rarely crystalline encrusted; CAULOCYSTIDIA abundant, often grouped, 23-100 x 7.5-13 µm at the base, 4-8 µm broad at the apex, truncate at the base and tapering upward to the subcapitate tip, hyaline or yellowish, with thicker walls than the other cystidia (1-3.5 µm), smooth; PILEAL SURFACE hymeniform, with a palisade of clavate to saccate-pedicellate cells, 12-22.5 x 5.5-9.5 µm, smooth and hyaline.

HABITAT: On Douglas fir, Pseudotsuga menziesii, cones in dense conifer forests with needle-litter floors, in autumn.

MACROCHEMICAL REACTIONS: All reactions were negative.

MATERIAL STUDIED: WASHINGTON, King Co., W. A. Murrill 439, (type - Seattle), W216 (U.W. Campus), W230, W1160 (Water main Woods, Redmond), W240, W244,W867, W1127 (McClellan's Butte Trailhead); Thruston Co., W1045, W1047 (Tenino Mounds); Chelan Co., W266 (Snow Creek Trailhead); Whatcom Co. W324 (Baker Canyon Creek Rd.); San Juan Co., W563, W1740 (Friday Harbor Biological Station). IDAHO, W910 (Collin City Dump, near Priest Lake).

16. *Strobilurus* *lignitilis* Wells and Kempton Mycologia 63:375. 1971. Plate V

PILEUS 1-3 (5) cm broad, convex, becoming plane, margin remaining inrolled or becoming almost straight, white to medium or dark sooty brown, hygrophanous and drying somewhat paler, darkest centrally and fading toward the margin; surface dull, finely pubescent under a lens, not translucent-striate or only so on very margin, sometimes shallowly plicate there as well, especially in the dry condition; context thin and tough-pliant, odor and taste not distinctive.

LAMELLAE white, occasionally tinged yellow in drying, sinuate to almost free, subventricose, blunt at the stipe apex, sharp-pointed towards the margin, edges even and pubescent, rather broad, 2-4 mm, thin and crowded.

STIPE 2.5-8 cm x 1-4 mm, white at the apex, becoming increasingly yellow downward, ochraceous buff mycelium covering at least the lower half, equal, surface like the cap, finely pubescent, becoming densely matted wooly-tomentose over the whole length of the pseudorrhiza (generally equal to or surpassing the aerial portion), often with humus adhering to the tomentum, sometimes naked and with rhizomorphs, hollow, and tough-pliant.

SPORES 5-7.5 x 2.5 - 3 µm, smooth, ovate to ellipsoid, hyaline, thin-walled, and nonamyloid; BASIDIA 20-25 x 3-5 µm, four-spored or two-spored (the spores then in two sizes, the larger range 7-9.5 x 2.5-3 µm), long and narrow; GILL TRAMA of subparallel, hyaline hyphae 4-15 µm in diameter; PILEAL SURFACE a palisade of clavate to saccate-pedicellate, hyaline cells 20-45 x 7.5-24 µm; NO CLAMP CONNECTIONS; PLEUROCYSTIDIA and cheilocystidia similar, the cystidia of the gill edge somewaht more abundant and longer than those on the face, more frequently subcapitate, both subcylindrical to narrowly ventricose, with obtuse to subcapitate apices, usually thin-walled, occasionally with the wall

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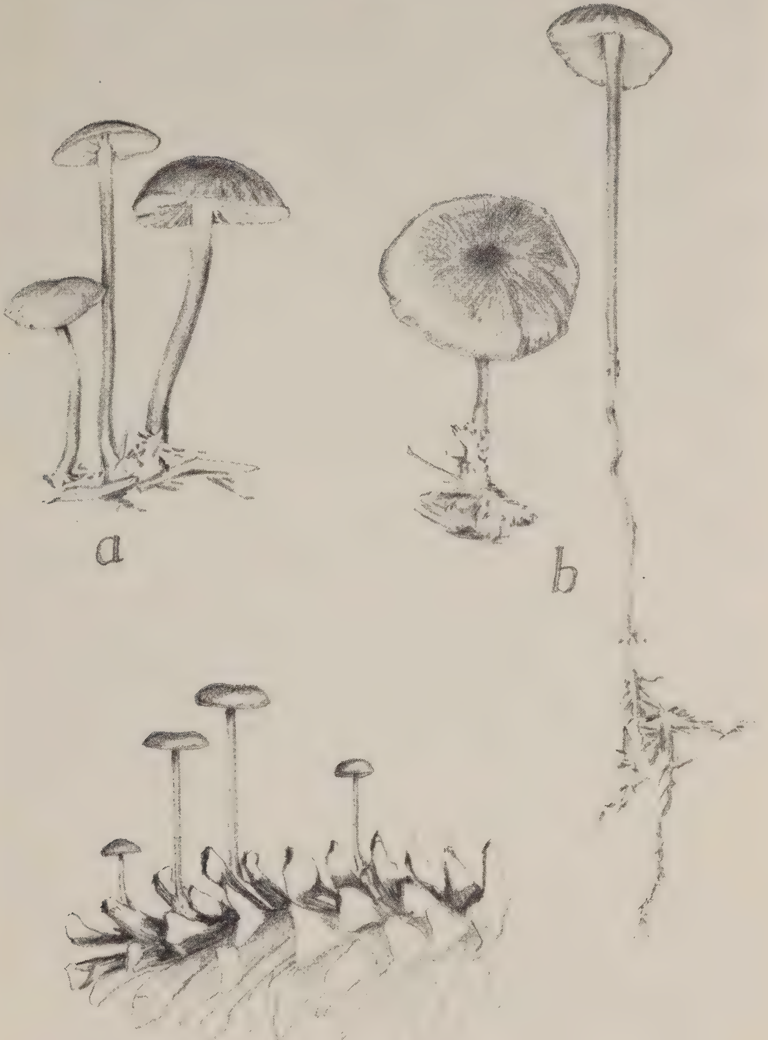
PLATE V -; a - *Strobilurus* *occidentalis*, W912, x 1; b - *Strobilurus* *lignitilis*, W1458, x 1; c - *Strobilurus* *albipilatus*, W967, x 1.

V



to 2 µm thick; PILEOCYSTIDIA scattered to abundant, 65-175 x 7.5-15 µm, generally about 100 µm long, narrowly ventricose to ventricose-rostrate, with obtuse to subcapitate apices, hyaline to yellowish, thin-walled and generally smooth, rarely crystalline encrusted; CAULOCYSTIDIA abundant, often groupd 70-150 µm long, 7-15 µm at the base and 4-9 µm broad at the apex, narrowly ventricose with subcapitate to capitate apices, truncate at the base, hyaline to yellowish, thin-walled to moderately thickened (1-2 µm), smooth or irregularly encrusted at the apex.

HABITAT: In mossy dense conifer forests, scattered to caespitose, often then with the stipes fascicled on decaying conifer wood which frequently is buried.

MACROCHEMICAL REACTIONS: No reagent gave even a faint positive reaction.

MATERIAL STUDIED: WASHINGTON, Clallam Co., W1142 (Heart O' the Hills Cmpgr.); Snohomish Co., W1154 (White Chuck River); King Co. W873 (Miller River cmpgr.), W1133 (Dorothy Lake Rd.); Thurston Co., W976, W978 (Tenino Mounds); Pierce Co., W897 (Ipsut Creek, Mt. Rainier Nt. Pk.); Skamania Co., W1448 (Iron Butte); IDAHO, W915 (Priest River Experimental Forest, USDA).

17. Strobilurus occidentalis Wells and Kempton. Mycologia 63:372. 1971.
Plate V

PILEUS 6-15 mm in diameter, convex with margins incurved becoming broadly convex to subplane, often obscurely unbonate; subhygrophanous and hardly changing color, nearly white if heavily shaded, otherwise tan to medium or dark grey-brown, margins often paler; surface dry, unpolished, smooth to subrugose, margin obscurely translucent-striate when moist; context white, thin to membranous (up to 0.5 mm), pliant, odor none or slightly of radish, taste none.

LAMELLAE white, narrowly adnate, sinuate, to almost free, subventricose, sharp-pointed at the margin, blunt at the stipe, thin, close, moderately broad, 1-2.5 mm.

STIPE 1-3 cm long, often with a pseudorrhiza which may double or triple this length, 1-2 mm broad, white, soon orange-brown from the base upwards, apex remaining white; dry, densely pruinose under a hand lens. pseudorrhiza covered with pale ochre-orange floccosity; equal, stuffed becoming minutely hollow, rather tough.

SPORES 4-7 x 2.5-3.0 µm, ellipsoid, hyaline, smooth, thin-walled and nonamyloid; BASIDIA 18-22 x 4-5.5 µm, four-spored or two-spored; GILL TRAMA of subparallel, hyaline, smooth hyphae 3.5-12 µm broad, nonamyloid; CONTEXT of the pileus of interwoven hyphae similar to those in the gill trama; PILEAL SURFACE hymeniform, a palisade of clavate to saccate-pedicillate cells, hyaline to very pale brown, 13.5-35 x 5.5-17 (25) µm; NO CLAMP CONNECTIONS; PLEUROCYSTIDIA infrequent to moderately abundant, 34-55 x 5.5-15 µm, ventricose with obtuse to subcapitate apices, hyaline to yellowish, smooth or minutely encrusted on or near the apex, usually thin-walled but wall sometimes 1-2 µm thick; CHEILOCYSTIDIA (20) 26-50 x 7.5-11.5 µm, otherwise similar to pleurocystidia though often more distinctly subcapitate; PILEOCYSTIDIA infrequent to moderately abundant, 30-70 (80) x 5-11 µm, ventricose with obtuse to subcapitate apices, hyaline to yellowish, thin-walled, smooth or rarely scantily encrusted; CAULOCYSTIDIA abundant (30) 40-115 µm long, 7.5-20 µm broad at the base, 3.5-6.5 µm at the apex, ventricose with obtuse to subcapitate apices, often truncate at the base, hyaline to yellowish, thin to moderately thick-walled (to 2 µm), smooth or irregularily encrusted on or near the apex.

HABITAT: In dense conifer woods, on buried wood or cones of spruce (Picea stichensis and P. glauca), mostly one but sometimes 2-3 fruiting bodies per cone, early spring or late autumn.

MACROCHEMICAL REACTIONS: No data available.

MATERIAL STUDIED: WASHINGTON, Whatcom Co., W325 (Baker Canyon Creek Rd.); Clallam Co., W1009 (Deep Creek); IDAHO, W919 (Bindarch Creek, Priest River), W912 (Collin Cith Dump and Swamp, Priest River).

The above description was taken almost directly from that of Wells and Kempton (1971). All the collections that I examined were not found on cones of Picea, but rather on wood, and seemed to match this species the closest. (Spores larger than in S. trullisatus and pileocystidia much shorter than those of S. lignitilis). Wells and Kempton use the occurrence on Picea cones as a fundamental distinguishing feature of the species, and since none of my collections were found on this substrata, I felt their description of the species should be followed as closely as possible.

18. Strobilurus albipilatus (Peck) Wells and Kempton. Mycologia 63:377. 1971

Figure 15 and 16, Plate V

Basionym: Collybia albipilata Peck. N. Y. State Museum Rep. 49:40. 1896.
Synonym: Gymnopus albipilatus (Peck) Murrill. N. Amer Fl. 9:366. 1916.

PILEUS 0.5 to 1.0 cm, light pinkish buff to brown, uniform or lighter on the margin, hygrophanous and fading to a uniform pinkish white or with a darker pinkish patch on the disc (5A2 or lighter when moist, drying to an even lighter shade, no match); convex becoming plane, sometimes centrally depressed, margin remaining somewhat inrolled or becoming straight, even; surface dull, faintly shiny when moist and translucent-striate almost to the disc then as well, finely pubescent under a lens; context membranous, rather fragile when moist, becoming tough in drying; taste and odor none.

LAMELLAE white, sinuate and rounded behind, subventricose, narrow to rather broad, very thin, close, edges even, concolorous and pubescent, 3 tiers.

STIPE 1.0-2.7 cm x 1 mm or less, white at the apex, yellowing downward, never becoming ochraceous at the base but rather a bay color (5A3); pubescent at the apex and almost all the way to the base, terminating in a fibrillose radicating base, this pseudorrhiza rarely more than a third the length of the aerial portion, equal, hollow, rather watery when moist, becoming tougher in drying, also somewhat shining under the pubescence then.

SPORES 4-5 x 2.5-3.0 (3.5) µm, ovate to ellipsoid, smooth, thin-walled, hyaline, and nonamyloid; BASIDIA slender, with long divergent sterigma, 16-21 x 3-5 µm, four-spored; NO CLAMP CONNECTIONS; PILEAL SURFACE hymeniform, a palisade of subclavate to saccate-pedicillate cells, 17-23 x 4-12 µm, smooth, hyaline, thin-walled and nonamyloid; PLEUROCYSTIDIA abundant, 42-55 x 8-9.5 µm at the base, narrowly ventricose and tapering to the apex, rounded to semiacute, thin-walled and hyaline; CHEILOCYSTIDIA infrequent to moderately abundant, differing from the pleurocystidia by being shorter on the average, more cylindrical, and having apices which are rounded to subcapitate, 33-48 x 8-11 µm, hyaline, thin-walled to moderately thickened, to 1.5 µm, neither crystalline-encrusted nor with a head of slime; PILEOCYSTIDIA infrequent to moderately abundant, 47-57 x 6.5-19 µm, ventricose with obtuse to subcapitate apices, hyaline to yellowish, thin-walled, smooth; CAULOCYSTIDIA abundant and often clustered, 48-75 long and 11-15 µm at the base, 3.5-5.5 µm broad at the apex, ventricose with subcapitate apices, sometimes obtuse, generally truncate at the base, hyaline to yellowish, wall thin or usually thick-walled, and yellow, to 2.5 µm, smooth.

HABITAT: On cones of Pinus, scattered to gregarious.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap negative to all macrochemical reagents.

MATERIAL STUDIED: NEW YORK, West Albany (type); IDAHO, Bonner Co., W967 (Bindarch Creek).

Wells and Kempton have separated this species from the others found in Washington or Alaska by the presence of acute caulocystidia, which were illustrated by Smith (1938) in his study of the type. In my study of the type I found only subcapitate to obtuse, never subacute, caulocystidia. In addition, this species seems very close to both S. ligni-

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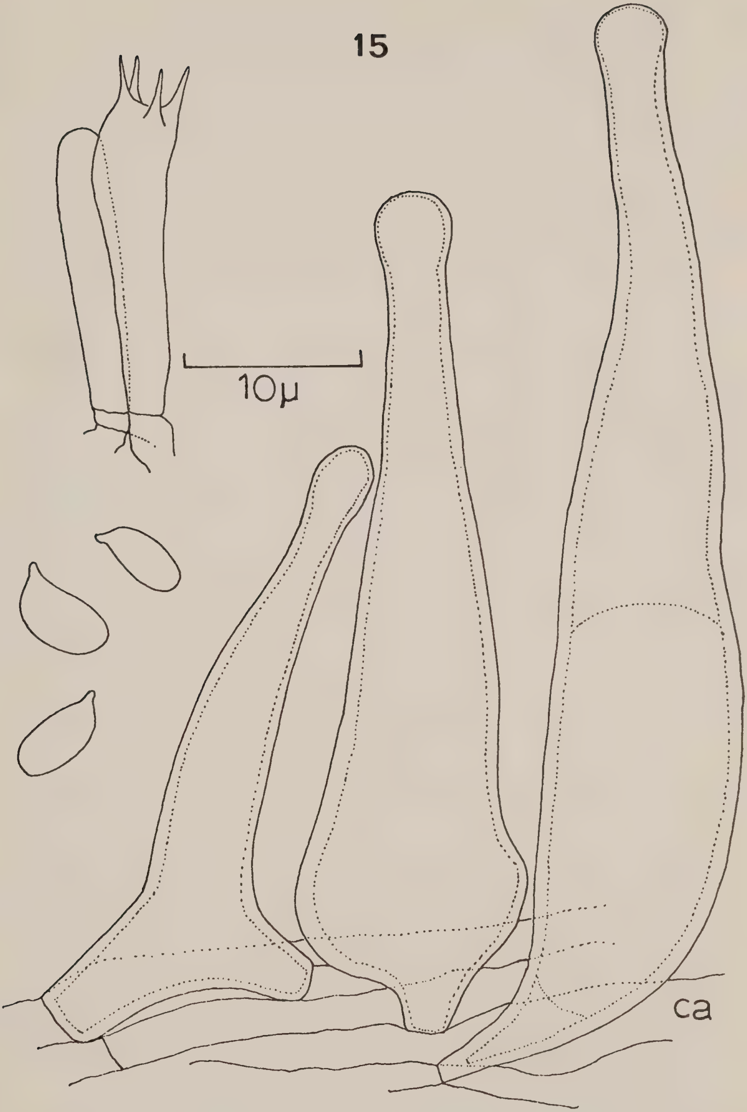


Figure 15. - Strobilurus albipilatus, Peck type, basidium, spores, caulocystidia (ca).

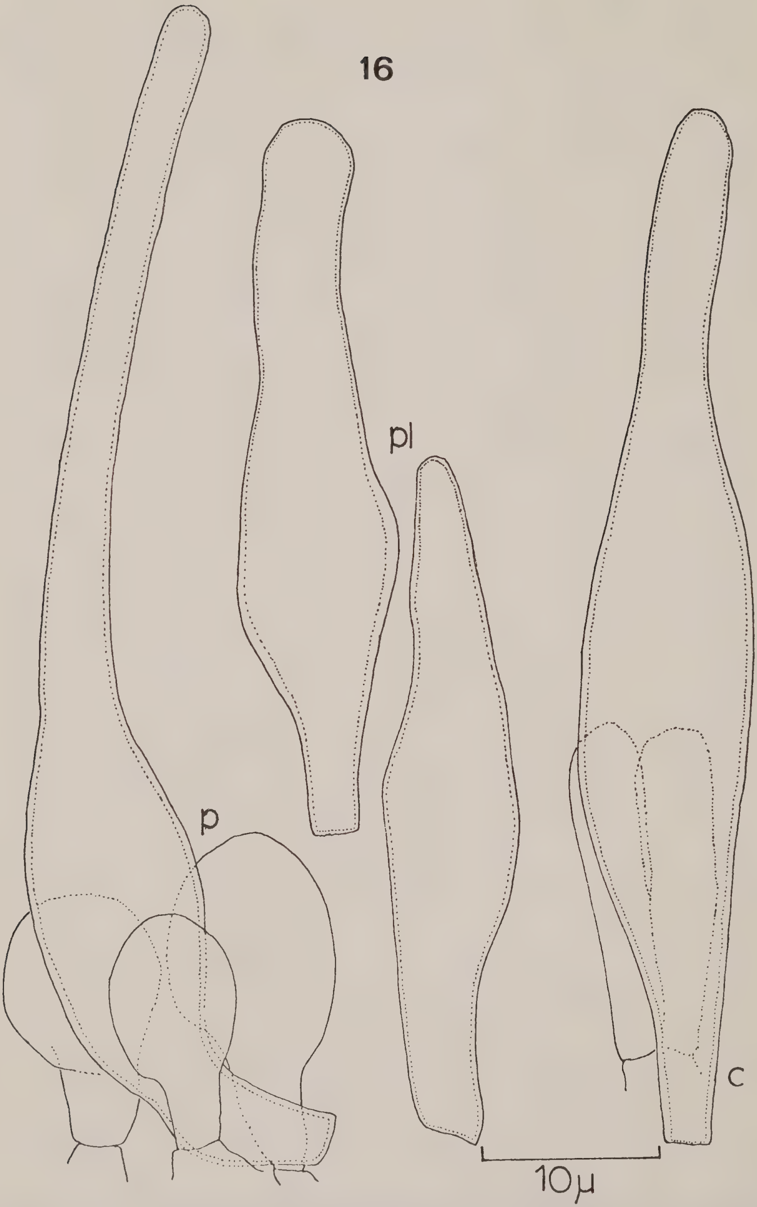


Figure 16. - Strobilurus albipilatus, Peck type, pleurocystidia (pl), cheilocystidia (c), hymeniform elements of pileal surface and pileocystidia (p).

tilis and S. occidentalis as they are described by Wells and Kempton; however, they had not been able to examine any material they considered to be representative of this species. The Idaho collection seemed to match the type quite well, but better fresh descriptions would help the delimitation of this species. At present, it appears that S. albipilatus is best distinguished by its smaller, buff or brownish, transluscent-striate cap; a shorter, paler stipe with the rooting and tomentose character less well developed than the other species; its habitat on Pinus cones, and a differentiation between cheilocystidia and pleurocystidia, the latter being longer, less cylindrical, tapering, and with apices generally obtuse to subacute, rather than subcapitate.

MICROCOLLYBIA Lennox nom. nov.

Pileus collybioideus, pusillus, convexus mox planus, ex albido ad incarnatum vel griseifulvum varians, caro membranacea et tenax, odor atque sapor haud propria; lamellae pileo concolores, anguste adnexae, tenues, confertae; stipes pileo concolor, aequalis, teres, solidus, pagina pruinosa dein tomentosa et interdum undulata, ad basim vulgo radicans, plerumque ex sclerotio luteo, badiibrunneo vel atro exoriens; sporae pusillae, 6 µm vel minus quam 6 µm longae, ovatae vel ellipsoideae, hyalinae, inamyloideae; cheilocystidia desunt; trama lamellarum subparallela, fibulas praebens; pagina pilei haud evoluta, vulgo subgelatinata, et pileocystidia filamentosa vel irregulares praebens; tomentum stipitis filamentosum.

Synonym: Microcollybia Métrod, nom. subnudum. Rev. Mycol. 17:75. 1952.
Collybia pro parte Kummer. Führ. Pilzk. p. 26. 1881.

Type species: Microcollybia tuberosa (Bull. ex Fr.) Lennox.

PILEUS and aspect collybioid, small, rarely exceeding one cm and usually less than 5 mm in diameter, convex and then plane, either somewhat umbilicate or umbonate, generally not strongly so, margin remaining inrolled or becoming straight, often furrowed or shallowly plicate; surface uniform or concentrically rivulose, with a thin pulverulent white tomentum, sometimes evanescent, silky to opaque; generally light-colored with a yellowish to flesh-colored disc, more rarely greyish brown; subhygrophanous, and unchanging in handling and in drying; flesh membranous, tough, reviving; odor and taste not distinctive.

LAMELLAE concolorous with the cap, white to grey-brown; generally sharply and narrowly adnexed, thin, crowded, rather broad, edge even and concolorous, blunt-pointed both towards the stipe and margin.

STIPE concolorous with the cap and gills, white to pinkish or greyish-brown, equal, rarely tapering somewhat upward, outline sometimes undulate, often flexuous at the base; surface pruinose-powdery, especially at the base, sometimes glabrous at the apex, base generally rooting for a short distance, then tomentose to strigose, often with abundant white to brownish rhizomorphs; almost filiform, terete, and solid; generally with a conspicuous, buried, yellow, bay-brown, or black sclerotium.

SPORES ovate to ellipsoid, thin-walled, hyaline, nonamyloid, small, generally 6 µm in length or less; BASIDIA thin-walled, four-spored and noncarminophilous; CHEILOCYSTIDIA usually not differentiated or if present than clavate to filamentous, contorted, rarely exceeding the basidia by 10 µm and quite inconspicuous; PILEOCYSTIDIA frequently present, rare to abundant, filamentous to clavate-contorted, grouped, arising directly from the surface layer, often as upturned hyphal ends. hyaline, thin-walled, sometimes septate; STIPE VESTURE similar to the cap or more often a tomentum of filamentous thin-walled cells of uniform narrow diameter, grouped and tangled, especially prominent in the lower half; GILL TRAMA subparallel, regular, loose, partially interwoven, with large prominent clamps, generally with a narrow, compact, ramose subhymenium; PILEAL SURFACE undifferentiated or a thin, amorphous, gelatinized layer cementing the upper cell layer, these cells similar to those of the context, radial to somewhat interwoven, rather coarse, loose, clamped, thin-walled, hyaline, not encrusted, and nonamyloid.

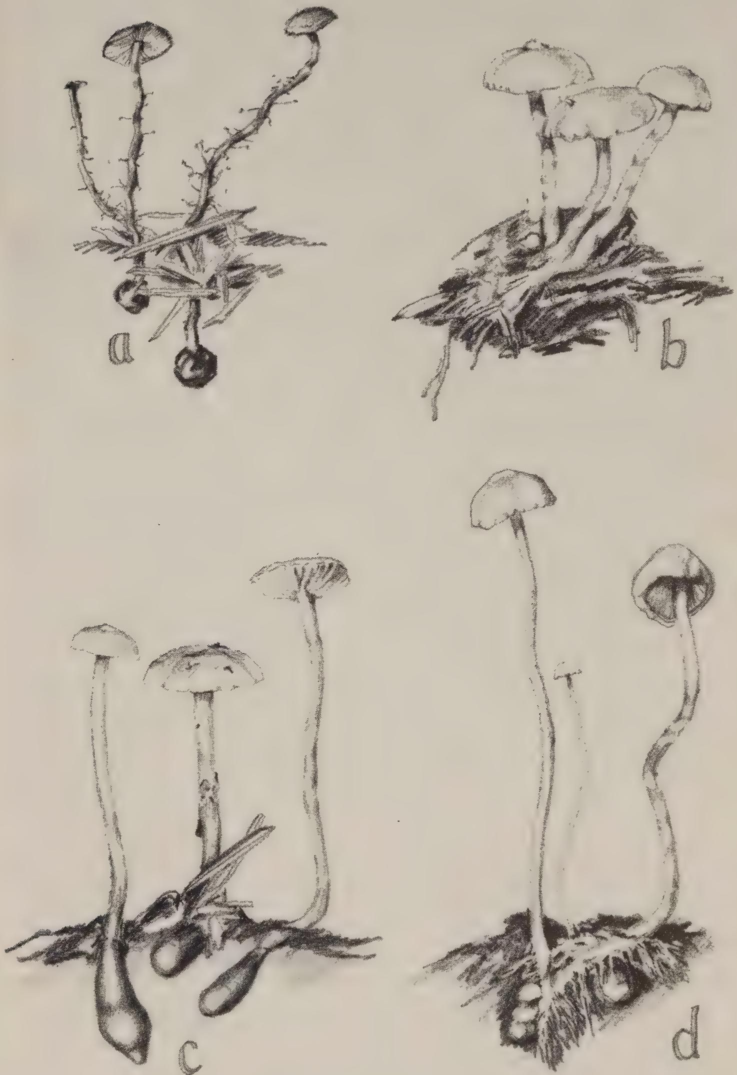
MACROCHEMICAL REACTIONS: *Microcollyia racemosa* is almost completely unreactive, while the pallid species of the genus tend to be rather widely reactive, reacting with aniline (yellow to orange), alpha-napthol, guaiacol, sulfoformol (yellowish to pink), phenol, and phenol-aniline.

HABITAT: On the much decayed carpophores of agarics and polypores, this appearing as a dried tarry substrate overlying humus or soil, occasionally without any evidence of such a substrate and thus appearing to grow directly on humus; rarely solitary, usually very abundant and somewhat crowded, then gregarious to subcaespitose.

The genus is easily recognized by its small, tough, carpohores which lack any remarkable microscopic features and which are normally found emerging from a sclerotium on the remains of much decayed agarics. The three species of whitish *Microcollybias*, *M. tuberosa*, *M. cirrata*, and *M.*

PLATE VI -; a - *Microcollybia racemosa*, W907, x 1; b - *Microcollybia cirrhata*, W1135, x 2; c - *Microcollybia tuberosa*, W905, x 2; d - *Microcollybia cookei*, W1158, x 2.

VI



cookei, are distinguished almost exclusively on the basis of the presence or absence of a sclerotium, and its shape and color. There are other differences between the three species but they are subtle and do not lend themselves as diagnostic tools. The most compelling evidence for maintaining the three species separate is the work of J. D. Arnold (1935), who demonstrated the incompatibility of both haploid and diploid mycelial interspecific matings (intraspecific matings were successful). Another important observation was made in the same work: all three of the species were capable of surviving, reviving and producing spores after drying for two months. This character of marcescense would place the genus very close to Marasmius. It lacks however any microscopic feature that characterize the marasmii. It probably would be most often confused with members of the genera Baeospora and Strobiluris which it resembles generally in color and stature, but both of these genera are found on conifer cones or wood and can easily be distinguished by their abundant, conspicuous cystidia, amyloid spores, or absence of clamps.

Key to the Microcollybia Species

1. Carpophores greyish-brown, the stipe with prominent side branches arising at right angles to the stipe and bearing slime heads of conidia, sclerotium subglobose, shiny, and coal black.. Microcollybia racemosa (p. 191)
1. Carpophores whitish, often with a pale yellowish or pinkish tinge, especially on the disc, lacking conidial side branches on the stipe, with or without a sclerotium.. 2.
    2. Carpophores not arising from a sclerotium, with a prominent strigose base and abundant white rhizomorphs, the stipe clothed with filamentous hairs of uniform narrow diameter................................ Microcollybia cirrhata (p. 193)
    2. Carpophores arising from a prominent yellowish or mahogany brown sclerotium, stipe base not strigose, usually with an appressed white tomentum, sometimes with rather coarse white rhizomorphs, the stipe clothed toward the base with filaments of narrow regular diameter or with short cystidia of irregular shape and diameter. .... 3.
3. Carpophore arising from a yellow pumpkin-shaped sclerotium; pileocystidia differentiated, grouped, rare to abundant; cheilocystidia lacking................................ Microcollybia cookei (p. 194)
3. Carpophores arising from an apple-seed-shaped, mahogany red-brown sclerotium; pileocystidia undifferentiated, or only an occasional hair-like projection; cheilocystidia present, clavate-contorted to filamentous, inconspicuous.. Microcollybia tuberosa (p. 196)

19. Microcollybia racemosa (Pers ex Fr.) Lennox comb. nov.

Figure 17, Plate VI

Basionym: Agaricus racemosus Pers. ex Fr. Epicrisis, p. 90. 1836.
Synonyms: Collybia racemosa (Pers. ex. Fr.) Quélet. Champ. Jura. Vosges. Ser II(5):342. 1873.

Illustrations: Persoon, Tentamen, tab. 3, fig. 7-8; Brefeld, Untersuch 8(1889), tab. 4, fig. 17-19; Sowerby, Col. fig., tab. 287; Revue Mycol. 10(1888). pl. 68, and 27(1905), pl. 247, fig. 1-6.

PILEUS 3-10 mm, convex and then plane, with a broad obtuse umbo, margin strongly inrolled in the immature specimens and in drying, remaining somewhat to strongly inrolled at maturity, becoming frayed and splitting, shallowly striate-grooved, frequently slightly crenate; medium fuscous brown, darkest at the center, fading uniformly toward the margin (5D7 on the disc, 5E4 elsewhere), subhygrophanous and drying only slightly lighter (5E5); innately silky, appearing silvery toward the margin when dry; context very thin, tough-pliant, concolorous; no taste or odor.

LAMELLAE somewhat paler than the cap, greyish brown (5C4 to 5B4), very narrowly and sharply adnexed, narrow, thin, and close, 2 tiers, edges even and concolorous, consistency somewhat tough.

STIPE 3-5 cm x 0.5-1 mm, concolorous with the cap or somewhat lighter, uniformly colored (5E5); equal above the substrate, generally tapering below this point, racemose, the projections arising at right angles to the stipe, absent in the upper aerial half, 1-1.5 mm long, capped with a slime head of conidia; faintly pruinose, terete or compressed, flaccid, often prostate, frequently buried for its entire length and entwined around portions of the substrate, arising from a subglobose, shiny, coal black sclerotium, watery greyish and homogeneous inside the thin, black coat, 2-7 mm in diameter.

SPORES 4-5.5 x 2.5-3 µm, ovate, thin-walled, hyaline, contents homogeneous, faintly bluish in Melzer's solution; BASIDIA 16-20 x 3.5-4 µm, rather narrow, tapering gradually toward the base, four-spored, noncarminophilous; no cystidia differentiated; PILEAL SURFACE a cutis of radial, somewhat agglutinated, rather coarse hyphae differing chiefly in size from the underlying tissue, 1-3 µm in diameter, becoming 5-7 µm broad in context, clamped, melanized and encrusted with shallow irregular concretions, most conspicuous in the surface cells; GILL TRAMA subparallel, somewhat interwoven, clamped, with a narrow, branched compact subhymenium composed of hyphae 2-3 µm in diameter; CONIDIA 8.5-12 x 4-5 µm, peanut shaped, nonamyloid, noncarminophilous,

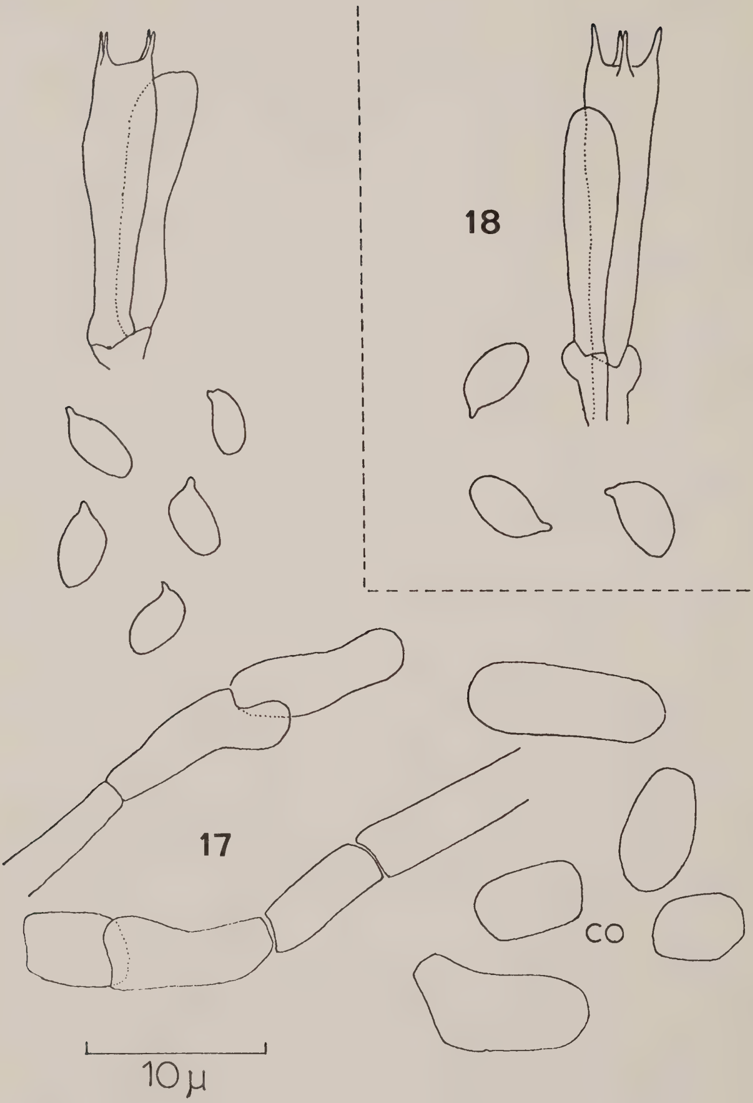


Figure 17. - *Microcollybia racemosa*, W907, basidium, spores, and conidia (c); Figure 18. - *Microcollybia cirrhata*, W1135, basidium and spores.

clamped, produced by the fragmentation of coarse mycelium.

MACROCHEMICAL REACTIONS: All reagents failed to produce color changes. The dark fuscous tones of the carpophores may mask weaker reactions with some of the reagents.

HABITAT: On the much decayed remains of agarics, or in deep coniferous duff, gregarious to subcaespitose.

MATERIAL STUDIED: WASHINGTON, Snohomish Co., W1153 (Verlot Ranger Station); King Co., W1663 (Annette Trailhead); Thurston Co., W1028 (Tenino Mounds); IDAHO, W907 (Collin City swamp).

This species is rarely collected probably due to its small size, camouflage color, and tendency to be immersed in the substrate. Once encountered, however, it usually does not present any difficulties in identification; its size, coloring, unusual side-branches on the stipe, and presence of a sclerotium set it aside from all other agarics immediately.

20. *Microcollybia cirrhata* (Pers. ex Pers.) Lennox comb. nov.

Figure 18, Plate VI

Basionym: *Agaricus cirrhatus* Pers. ex Pers. Mycol.
Europea. Vol 3:125. 1828.
Synonyms: *Collybia cirrhata* (Pers. ex Pers.) Quélet.
Champ Jur. Vosges. Sér. II(5):96. 1872.
Illustrations: Britz, Hymenon., tab. 2, fig. 4; Fries; Icones Hymenon., tab. 68, fig. 1; Gillet, Champ. Fr., Hymenon., tab. 542; Bresadola, Inconographia Mycol., tab. 205.

PILEUS 2-12 mm, white at the margin, light warm tan at the center (5B3), spotted at the disc or fading uniformly to the margin, hygrophanous and becoming uniformly colored (5A2); convex becoming plane, occasionally depressed slightly at maturity, often shallowly papillate to broad umbonate, margin either slightly inrolled or straight at maturity, moist and then striulate for one half to one quarter the radius, grooved-undulate at the edge, fraying with age; surface dry-matte, opaque, slightly powdery, minutely rugose under a lens; context thin, concolorous, rather soft and fragile; odor none, taste none or farinaceous.

LAMELLAE white or pallid, arcuate, broadly adnate to slightly sinuate, blunt-pointed at the stipe attachment, sharp-ended toward the margin, edge even and concolorous, thin, subdistant, 20 lamellae reaching stipe apex, 3 tiers of lamellulae, narrow, about 1 mm in depth.

STIPE 12-25 mm x 1 mm or less, concolorous with the disc of the cap or darker, pale warm buff (5B4), somewhat more reddish toward the base with age, equal, outline often rather wavy, especially in the lower half, flexuous; surface powdery-pubescent above, becoming tomentose below, strigose with white, bristle-like rhizomorphs near the substratum; solid with a lighter center; not arising from a sclerotium.

SPORES (5-) 5.5-7.5 x 2.5-3.5 µm, ellipsoid to cylindrical, smooth, thin-walled, hyaline, nonamyloid, white in deposit, contents homogeneous; BASIDIA 25-31 x 4-5 µm, four-spored, noncarminophilous; PILEAL SURFACE undifferentiated from the context, of rather coarse hyphae, loose, partially interwoven, clamped, nonamyloid; GILL TRAMA subparallel, loose, partially interwoven, clamped, nonamyloid; no cystidia differentiated.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react with aniline (weak, variable reaction, yellowish to pinkish), alpha-napthol, guaiacol, phenol, and phenol-aniline.

MATERIAL STUDIED: WASHINGTON, Snohomish Co., W1180 (Buck Creek campground); King Co., W251 (Snoqualmie Pass), W1131 (McClellans Butte Trailhead), W1135 (Dorthy Lake Rd), W1662 (Annette Lake Trailhead); Kittitas Co., W1120 (Blankenship Meadows Trail); Jefferson Co., W1173 (Dosewallips Campground); Clallam Co., W1136 (Heart O' the Hills).

This species seems to be much more common in this area than either of the other two whitish species of the genus. It is distinguished chiefly by the absence of a sclerotium, and its larger spores.

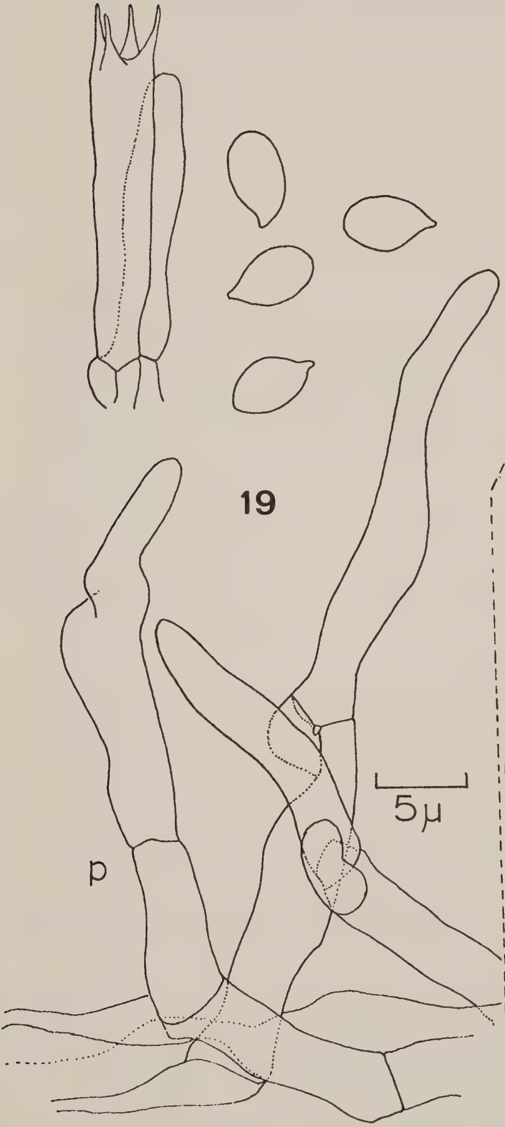
21. Microcollybia cookei (Bres.) Lennox comb. nov.

Figure 19, Plate VI

Basionym: Collybia cirrhata var. cookei Bres. Icones Mycol. Vol. 5 (suppl. 2):206. 1928.
Synonym: Collybia cookei (Bres.) J. Arnold. Mycol. 17(4):414. 1935.

Illustrations: Cooke, Illustr. Brit. Fungi, tab. 144, fig. B. (as Collybia cirrhata); Bresadola, Icones Mycol. Vol. 5 (suppl. 2):206. 1928.

PILEUS 2-9 mm, white to very pale pinkish or yellowish, uniformly colored, subhygrophanous and drying slightly pinker; convex, becoming plane, slightly depressed or umbilicate with age, shallowly papillate when young, margin somewhat inrolled or nearly straight, even, thin, moist-striatulate for one half the radius, later fraying; surface dull, somewhat shining if very moist, finely and innately fibrillose, minutely rugose under a lens; context very thin, membranous, rather tough, concolorous; no odor, taste none, or farinaceous and then delayed.



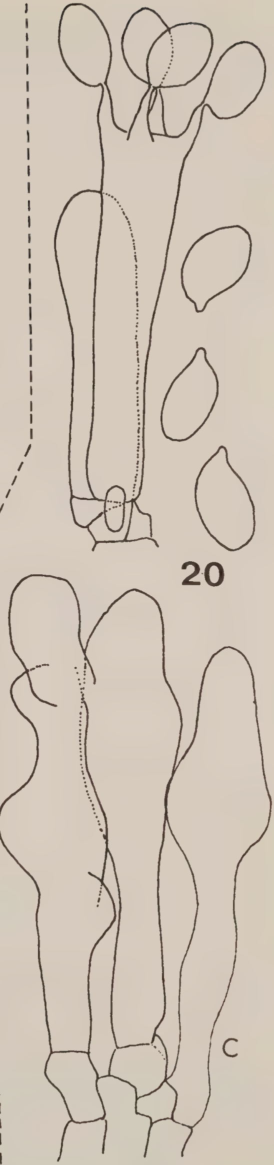


Figure 19. - *Microcollybia cookei*, W1158, basidium, spores, pileal surface with cystidia (p); Figure 20. - *Microcollybia tuberosa*, W1373, basidium, spores, cheilocystidia (c).

LAMELLAE white, drying pale pink (5A2), rather broadly adnate to sinuate, arcuate, thin, subdistant, 20 lamellae reaching stipe apex, narrow, 1 mm or less in depth, edges even and concolorous.

STIPE 0.6-6.0 cm x 1-2 mm, concolorous with the cap at the apex, generally slightly darker toward the base, pinkish (5D6), equal, outline often wavy, straight, then flexuous; surface pruinose at the top, becoming pubescent, scantily tomentose at the base, with white coarse bristle-like rhizomorphs there as well, often buried for half of the length, solid, terete, with a subhygrophanous lighter core, emerging from an orange-yellow (5A6) sclerotium that is 1-6 mm in diameter, irregular in shape, often somewhat flattened and pumpkin-shaped.

SPORES 4.5-5.5 (-6) x 2.5-3.5 µm, ovate, thin-walled, smooth, contents uniform, nonamyloid hyaline; BASIDIA 16-18 x 4-5 µm, rather small, tapering gradually to the base, four-spored, noncarminophilous; PILEOCYSTIDIA rare to frequent, arising directly from the surface layer, clavate to filamentous, contorted, grouped, 10-45 x 3-8 µm; cheilocystidia and pleurocystidia not differentiated; PILEAL SURFACE undifferentiated from the context, upper layer slightly gelatinized and agglutinated, not encrusted, composed of rather coarse hyphae averaging 3-5 µm in diameter, loose, nonamyloid; GILL TRAMA subparallel, partially interwoven, loose, clamped, composed of hyphae 4-8 µm in diameter, averaging 6 µm; STIPE VESTURE cystidioid, clavate-contorted, 5-30 x 3-10 µm, generally rather short and not exceeding 20 µm, thin-walled, not encrusted, sparingly branched and septate, hyaline, and clamped.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react with alpha-napthol, aniline (yellow to orangish), guaiacol, phenol, and phenol-aniline. Weak and ambiguous reactions also occurred with sulfoformol (pinkish), and ferric sulfate (greenish).

HABITAT: On much decayed mushroom remains, appearing as a black tarry substratum, gregarious to subcaespitose, generally very abundant.

MATERIAL STUDIED: WASHINGTON, King Co., W1128 (McClellans Butte, trailhead), W1158, W1685 (Water Main Woods); Mason Co., W1209 (Lower Lena Lake Trail).

Microcollybia cookei is very closely related to Microcollybia cirrata and M. tuberosa and is distinguished chiefly and most readily by the presence of a yellow to yellow-orange sclerotium. This sclerotium differs markedly in color from that of M. tuberosa, which is reddish-brown and strongly resembles an apple seed.

22. Microcollybia tuberosa (Bull. ex Fr.) Lennox comb. nov.
Figure 20, Plate VI

Basionym: *Agaricus tuberosus* (Bull.) Fr. Syst. Mycol. p. 133. 1821.
Synonyms: *Collybia tuberosa* (Bull. ex Fr.) Quélet. Champ. Jur. Vosges. Sér. II, 5:96. 1872.

Illustrations: Bulliard, Champ. Fr., tab. 256; Brefeld, Untersuch 8(1889), tab. 4, fig. 15-16; Britz, Hymenom., tab. 32, fig. 221; Cooke, Illustr. Brit. Fungi, tab. 144; Bresadola, Icon. Mycol., plate 207, fig. 1.

PILEUS 0.2-1.2 cm, white to pallid, center tinged a pinkish buff (5A2), subhygrophanous and drying slightly darker and more pinkish (4A3); convex becoming plane, with a shallow umbo in some immature specimens, often becoming somewhat centrally depressed with age, margin remaining slightly inrolled or becoming straight, often crenate and plicate-striate in older specimens, fraying then as well; surface moist-watery, often drier and dull, faintly pubescent, especially under a lens; context very thin, concolorous, rather soft when moist, much tougher in drying; odor faintly sweet or fungoid, taste none.

LAMELLAE white, occasionally tinged faintly pinkish, broadly adnate, appearing almost subdecurrent if the cap margin is raised far above the point of attachment, edge even and concolorous, thickish, rather broad, 1 x 2 mm, subdistant, 20 lamellae reaching the stipe apex.

STIPE 13-25 mm x 0.5-1.0 mm, at first concolorous, darkening slightly with age and handling, then pinkish (5A3), equal, flexuous at the sclerotium, surface powdery-pruinose at the apex, with a scant white tomentum below that and nearly strigose at the base; solid, or more rarely narrowly tubular, concolorous centrally, rather tough, especially in drying, never really pliant; arising from a prominent sclerotium, that is 4-13 x 2-9 mm, dark mahogany brown (8E8 to 8F8) to a light orange brown (6C6), often mottled ferruginous when lighter colored, often resembling an apple seed, the larger ones frequently bowed and narrowest toward the emergence end, white to cream within, solid and uniform, becoming longitudinally furrowed with age or drying, shiny; rarely with white bristle-like rhizomorphs.

SPORES 5-6.5 x 3-3.5 µm, ovate to cylindrical, hyaline, thin-walled, smooth, nonamyloid; BASIDIA 19-27 x 4.5-5.5 µm, long and narrow, four-spored, noncarminophilous; CHEILOCYSTIDIA not differentiated or if present then in a tight hymenium on the edge, resembling basidioles, 15-36 x 3-6.3 µm, clavate-contorted, never becoming filamentous; PILEAL SURFACE undifferentiated, composed of rather large, loose, clamped hyphae 4-8 µm in diameter, the uppermost cell layer somewhat gelatinized and compacted, not encrusted, thin-walled, nonamyloid, more or less radially oriented, somewhat interwoven; GILL TRAMA regular, subparallel to interwoven, clamped, nonamyloid, composed of hyphae 4-8 µm in diameter, subhymenium hardly differentiated, very narrow and compact, the hyphae 2-3 µm in diameter; STIPE VESTURE hairlike, uniform in diameter, 3-5 µm, nonencrusted, hyaline and thin-walled, tangled.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react positively with alpha-napthol, aniline (reaction very weak, yellowish to pinkish), guaiacol, sulfoformol (weak, yellowish), phenol-aniline, and phenol.

HABITAT: Scattered to subcaespitose, generally very abundant, on the hard tarry pad of a much decayed mushroom, in coniferous woods.

MATERIAL STUDIED: WASHINGTON, Skagit Co., W1673 (Mineral Park Campground); King Co., W610 (Lee Forest), Pierce Co., W1373 (Tahoma Creek, Mt. Rainier Ntl. Pk); IDAHO, Bonner Co., W901 (USDA Experimental Forest, Priest Lake), W905 (Collin City dump).

This species seems to differ primarily by the presence of the apple-seed like sclerotium, and appears to be much rarer than *Microcollybia cirrhata*.

RHODOCOLLYBIA Singer. Schweiz. Z. Pilk, 17:71. 1939.

Type species: *Rhodocollybia maculata* (Fries) Singer.

HABIT tricholomoid to collybioid, PILEUS generally quite large, often 5 cm or more in diameter, convex, becoming plane, frequently shallowly umbonate, rarely centrally depressed, surface often rather uneven, lubricous and shining, dull and matte in drying; whitish to dark reddish brown, generally staining ferruginous; context quite thick over the disc, tapering abruptly just at the margin, margin often curled and fraying in age; odor generally rather faint and pleasant, occasionally strong and characteristic, taste none to unpleasant and bitter.

LAMELLAE whitish to pinkish cream, narrowly adnexed, sinuate to emarginate, often slightly uncinate and the attachment slightly irregular, ventricose, thin, crowded, generally rather broad, edge concolorous but uneven, often either serrate in young specimens or frayed or eroded in age.

STIPE rather long and thick relative to the cap diameter, often exceeding 7 cm in length and having a breadth of at least 5 mm, whitish to concolorous with the gills; slightly expanded just at the apex, equal for most of the above ground length, expanded where radicating and then tapered abruptly, frequently staining ferruginous in contact with the substratum; faintly and finely pruinose at first, glabrescent and longitudinally striate in age, the radicating portion with a white appressed cottony tomentum; occasionally compressed, solid to spongy-stuffed, context white, fibrous and easily splitting and fraying, firm, not tough.

SPORES globose to ellipsoid, hyaline in transmitted light, endosporium dextrinoid (cyanophilous as well), thin to rather thick walled (0.5 µm), yellow to dark pinkish cream in deposit; BASIDIA four-spored, noncarminophilous, occasionally dextrinoid and appearing thick-walled and then frequently septate; CHEILOCYSTIDIA present or absent, if present thin-walled, hyaline, variable in shape, and not exceeding the basidia; PLEUROCYSTIDIA not differentiated; PILEAL SURFACE a layer of loosely interwoven hyphae, 2-5 µm in diameter, often partially gelatinized, generally not incrusted, nonamyloid, less compact than the layer immediately below, clamped; the context loosely interwoven, of hyphae 5-8 µm broad, nonamyloid, clamped, occasionally encrusted in upper more compact layer near the surface.

MACROCHEMICAL REACTIONS: The carpophores seem to differ rather widely in reactivity, some species reacting with almost all of the reagents used and others reacting with just a few. In most cases, the carpophores were negative to alpha-napthol, aniline, and guaiacol, and positive to phenol, and phenol-aniline.

HABITAT: Scattered to caespitose on thick duff or much decayed wood, in coniferous forests.

This genus is characterized by the large size of its carpophores and depth of the flesh of the cap; the reddish colors of the cap; the thin, crowded, broad, adnexed, pallid gills; the pinkish spore print, a subradicating and sulcate-striate stipe. Microscopically, these species are distinct due to the partially gelatinized, relatively large and loosely interwoven hyphae of the pileal surface, and also by the presence of dextrinoid spores, and scattered, dextrinoid thick walled basidia. The latter character, however, varies a great deal and in some collections may be overlooked: some specimens have so few spores that actually are dextrinoid that any one crush mount may contain only a few, while in the majority of collections, a crush mount will often contain about 25-50% dextrinoid spores.

Key to the Sections

I. Stipe subradicating in much decayed wood, conspicuously sulcate-striate, at least with age, often staining ferruginous slowly on cap, gills, or stipe, context of cap very thick, generally as deep as the depth of the gills............... Section *Maculata* (p. 200)

I. Stipe not radicating in much decayed wood, terrestrial, stipe glabrous, neither longitudinally striate nor sulcate; rarely staining rusty on any part; context of the cap relatively thin, 5 mm or less, less than the depth of the gills..................................... Section *Butyracea* (p. 218)

Section *Maculata* (Singer) Lennox stat. nov.

Basionym: *Collybia*, Section *Stripedes*, Stirps *Maculata* Singer. Agaricales in Mod. Tax., 1962.

Type species: *Rhodocollybia maculata* (Fr.) Singer.

Pileus very large, generally 5-12 cm, pallid to dark reddish brown; context thick, 5 mm. or more, often as deep as the gills; stipe conspicuously sulcate-striate, and subradicating; carpophores generally stained ferruginous in some part, especially in the lower part of the stipe; scattered to caespitose in much decayed wood.

Key to the Species

1. Majority of spores globose to subsphaerical, generally less than 6 µm in length, a small percentage approaching an ovate-ellipsoind shape............. 2.

1. The majority of spores ovate to ellipsoid, generally 6 µm or more in length, a very few subglobose .... 3.

    2. Stipe very dark sordid brown at maturity, cap pale to dark vinaceous or brown, odor aromatic, like benzaldehyde or almonds, taste none or mild. .... *R. subsulcatipes* (p. 201)

    2. Stipe white, cap pallid, blushing fulvous, spotting vinaceous, odor faint, taste bitter..... .... *R. maculata* var. *maculata* (p. 210)

3. Caps dark-colored both in young specimens and at maturity, dark vinaceous brown to fuscous (7E5 to 7F3)... 4.

3. Caps pallid, sometimes blushing fulvous centrally with age, frequently spotted ferruginous.......... 7.

    4. Odor very strong, of benzaldehyde or almonds, taste bitter, cap quite large, at least 4 cm in diameter............. *R. oregonensis* (p. 202)

    4. Odor if strong, not of benzaldehyde or almonds, taste none, or if bitter, cap dark fuscous brown; cap 4 cm or less.............................. 5.

5. Cap dark fuscous brown to fuscous vinaceous, lacking rusty stains on the gills or stipe, cap not umbonate.. 6.
5. Cap vinaceous brown, without any fuscous tone, staining ferruginous on the gills and lower stipe, cap umbonate........ R. maculata var. fulva (p. 210)
    6. Gills yellow to light orange, cap less than 4 cm, odor faint, rather sweet, taste bitter .... R. maculata var. nigra (p. 211)
    6. Gills white, cap 4.5-6.0 cm, odor penetrating, like Vicks or moldy cinnamon, taste none..... .... R. subnigra (p. 205)
7. Gills yellow (5A2 or 4A5), cap buff to fulvous, stipe often yellow with age..................... .... R. maculata var. scorzonerea (p. 214)
7. Gills white, unchanging, not yellow at maturity; cap pallid, or blushing bay centrally or with age, stipe whitish, not yellowing..................... 8.
    8. Carpophores cream white throughout, lacking rusty stains on all parts................... R. maculata var. immutabilis (p. 215)
    8. Carpophores pallid, generally light bay colored to fulvous on the cap with age, spotted ferruginous on cap, gills, and stipe............. .... R. maculata var. occidentalis (p. 217)

23. Rhodocollybia subsulcatipes (Smith) Lennox comb. nov.

Plate VII

Basionym: Collybia subsulcatipes Smith. Bull. Torrey Bot. Club. 71:396-7. 1944.

The description following is drawn from that of Smith (1944).

PILEUS 5.5-8.0 cm broad, when young "army-brown" to "vinaceous fawn" over all, disc becoming "russet-vinaceous" and margin "deep brownish vinaceous" (dark to pale vinaceous brown), hygrophanous and fading to a "pale vinaceous buff" (pallid vinaceous); convex, becoming plane, obtuse with an inrolled margin, becoming gibbous or plane, in age the margin recurved or elevated and frequently splitting, surface moist and polished, margin transluscent striate, hygrophanous and opaque when faded; flesh thin (2-3 mm), equal, firm and cartilaginous, concolorous with the surface of the cap; odor faint but heavy and aromatic (somewhat like that of benzaldehyde) very distinctive, taste mild.

LAMELLAE "pale greyish vinaceous" becoming "light russet-vinaceous" (grey with a tinge of vinaceous when young, becoming distinctly dull vinaceous in age), depressed adnate to nearly free, the lamellae quite irregular in arrangement, broad (1 cm ±), becoming slightly ventricose, close to nearly subdistant, 46-54 reach the stipe, 1-3 tiers of lamellulae, faces glaucous, edges thickish and even.

STIPE 6-10 (15) cm long, 10-16 mm thick at the apex, more or less concolorous with the pileus at the apex, becoming very dark sordid vinaceous brown from the base upward in age, tapering downward to a long pseudorhiza, surface pruinose but soon polished, smooth or longitudinally grooved to subsulcate, solid and fibrous within.

SPORES 5-5.5 x 4.5 x 5 µm, globose to subglobose, hyaline, smooth, not amyloid; BASIDIA 28-34 x 4.5-6 µm, four-spored, slender and subclavate; pleurocystidia and cheilocystidia not differentiated, GILL TRAMA parallel to subparallel, the hyphae more or less cylindrical; PILEAL SURFACE a narrow cutis of radially arranged subgelatinous hyphae 3-4 µm in diameter, context floccose, the hyphae 5-15 µm in diameter.

MACROCHEMICAL REACTIONS: No data available.

HABITAT: Gregarious on humus.

MATERIAL STUDIED: None (Note: the type locality and only reported collections of this species are from Storm King Mt., Clallam Co., Olympia National Park, Wash.).

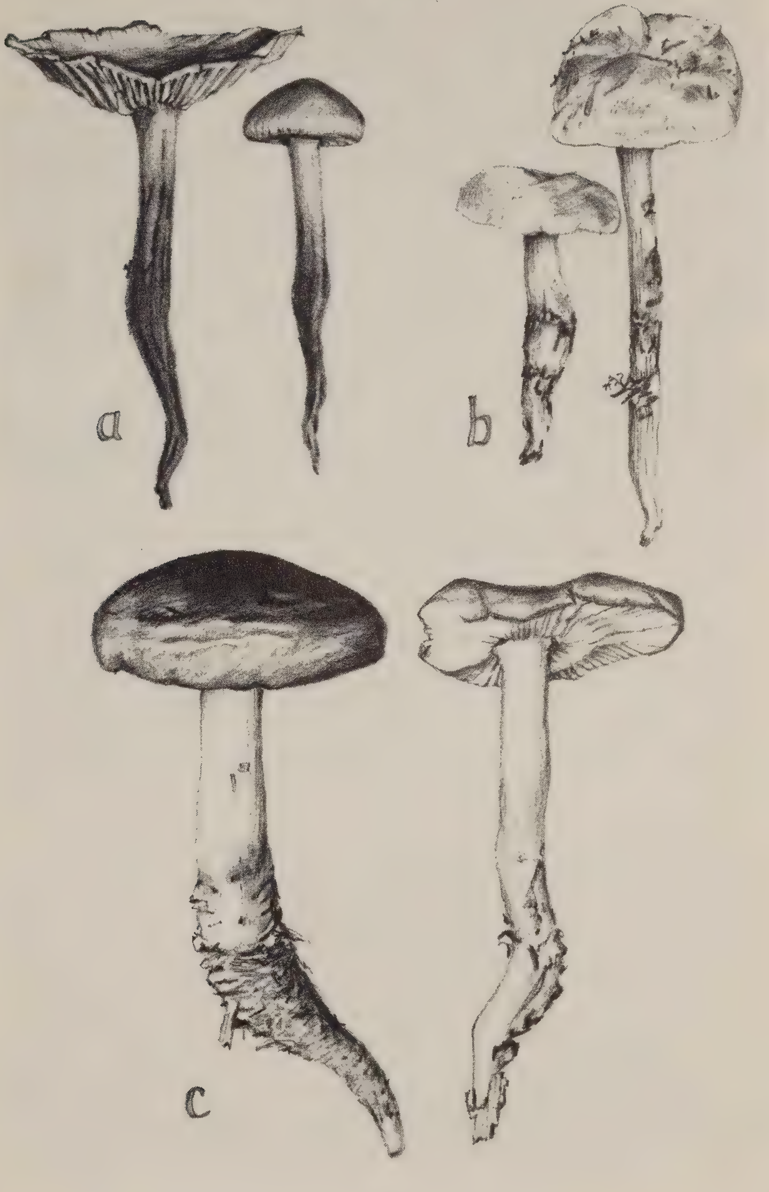
According to Smith "this species is closely related to *Collybia fusipes* but distinct because of its globose spores, odor, and vinaceous gills" (He examined material of *C. fusipes* provided by M. Josserand, Lyon). He further states that "the most obvious difference macroscopically is the color of the lamellae and their spacing. In *C. subsulcatipes* they are closer and more vinaceous. *C. oregonensis* has a similar odor but is readily distinguished by its ellipsoid spores, the color of the gills and stipe, and in general appearance. *C. oregonensis* is closely related to *C. maculata*."

24. *Rhodocollybia oregonensis* (Smith) Lennox comb. nov.

Figure 21, Plate VII

PLATE VII -; a - *Rhodocollybia subsulcatipes*, constructed from type description, x ½; b - *Rhodocollybia maculata* var, *maculata*, W1438, x ½; *Rhodocollybia oregonensis*, Scates 1178, x ½.

VII



Basionym: Collybia oregonensis Smith. Mycologia 29:47. 1937.

PILEUS 4-10.5 cm broad, generally at least 7 cm, very dark vinaceous brown or chestnut brown centrally, fading gradually and then abruptly towards the margin, warm buff to pale tawny there (8F7 or 8F8 at the center, 6B3 to 5A5 marginally), in older specimens colors uneven and spotted, subhygrophanous, and colors slowly losing their warm tones; convex to hemispheric, becoming plane and broadly but shallowly umbonate, margin never truly straight, sometimes frayed but even; surface subviscid when moist, glabrous or occasionally minutely fibrillose on the disc, sometimes obscurely silvery-spotted in drying; context firm-brittle when moist, pallid, tapering evenly to the margin and very thin at extreme margin, rather thick centrally, up to 1 cm, not tough, odor very distinctive, strong almond or benzaldehyde, taste faint and unpleasant or none.

LAMELLAE white to pale orange (4A3 to 5A2, no good match), yellowing in drying, sinuate-uncinate, some variation in insertion and degree of attachment, sharp-pointed towards the margin, blunt-ended at the stipe, ventricose, thin and crowded, 84 lamellae reaching stipe, 3 tiers of lamellulae, broad, 2.8-3.9 cm x 5-6 mm, edge concolorous, serrate to even when young, strongly eroded and fraying later, consistency soft, sometimes minutely transversely striate, frequently stained ferruginous.

STIPE 6.5-20 (30) cm long, 5-20 mm broad, white but staining ferruginous, especially towards base, equal for most of the length, inflated slightly in lower half and then tapering abruptly into a pseudorhiza-like prolongation, buried for about one-half of the length and covered there with pieces of rotten wood, surface powdery-pruinose at the apex, glabrous below, strongly striate-grooved; solid to somewhat hollow, uniform and white throughout, fibrous, becoming frayed and splitting, flexuous, without rhizomorphs.

SPORES 6-8 x 4-5 µm, ovate, thin-walled to thick-walled, hyaline, smooth, with dextrinoid endosporium or cytoplasmic contents which are frequently retracted from the apicular end, pale orange in deposit; BASIDIA 26-30 x 5-6 µm, two and four-spored, with dextrinoid endosporium which retracts into the upper or lower half of the basidium and creates a septate appearance; no cheilocystidia or pleurocystidia differentiated; PILEAL SURFACE a gelatinized cuticle 50-75 µm deep, composed of interwoven hyphae, with a few projecting hairs, overlying a zone of radial, tubular hyphae 4-8 µm in diameter, compact and encrusted in a short transversely banded pattern; CONTEXTUAL HYPHAE intergrading with the surface hyphae, interwoven, clamped, nonamyloid, not encrusted, quite loose, composed of hyphae 7-15 µm broad, averaging 10 µm; GILL TRAMA of tubular, parallel hyphae 3-15 µm in diameter, averaging 5 µm, subhymenium broad, 15-25 µm deep, coarse and interwoven.

HABITAT: Gregarious to caespitose on much decayed wood in dense woods.

MACROCHEMICAL REAGENTS: Gills and flesh of the cap react weakly with phenol.

MATERIAL STUDIED: WASHINGTON, San Juan Co., W1737 (Friday Harbor Biological Station); King Co., W1680 (PSMS Mushroom show); Pierce Co., W1680 (near Ohanopecosh); Skamania Co., W1439 (Cispus Training Center); IDAHO, Scates 1178 (Above Devil's Elbow Cmpgr., Coeur d'Alene River), Scates 1191 (Blue Creek Area).

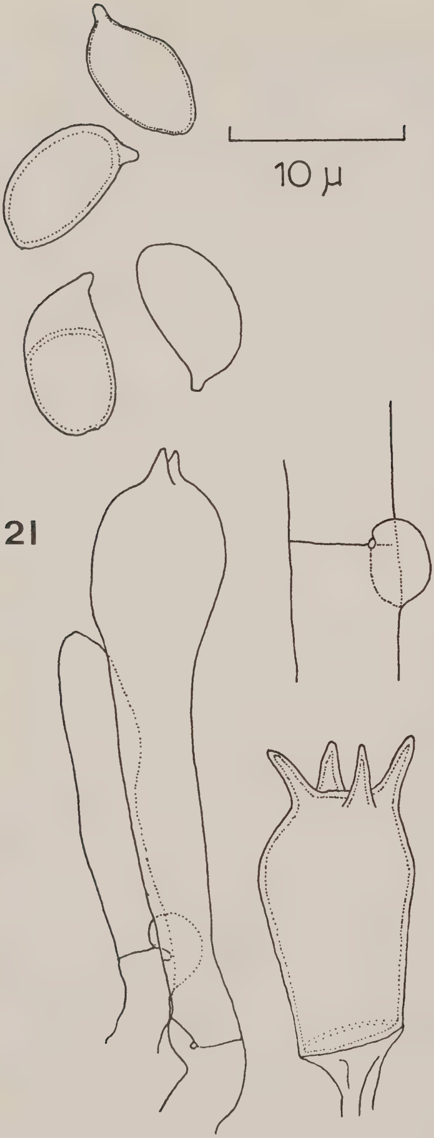
The most distinctive feature of R. oregonensis is the strong aromatic almond odor; in the dried condition, however, this species can be distinguished rather easily by the large dark vinaceous cap and large ovate to ellipsoid spores. It is closely allied to the R. maculata complex by its large size, thick cap, staining reactions, serrate gills, striate-grooved stipe, enlarged base, rooting and lignicolous habit.

25. Rhodocollybia subnigra Lennox sp. nov.

Plate VIII

Pileus 4.5-6 cm latus, atrorubrobrunneus, in sicco fuscobrunneus, leviter umbonatus, humidus et lubricus, in sicco impolitus, caro crassa, incarnatocremea, odore penetranti, "Vicks Vaporub" vel cinnamoni mucidi similis; sapor nullus. Lamellae albidae, immaculatae, adnexae, sinuatae, membranaceae, confertae, in senectute serratae. Stipes 8-10 cm longus, 9-20 mm crassus, pallide aurantiacus, in parte tertia versus apicem aequalis, in parte tertia ad medium expansus et ventricosus, basim versus abrupte angustatus, striato-sulcatus, fibrosus, in dimidio inferiore infossus. Sporae 6.5-7.5 x 3-4 mµ, ellipsoideae, dextrinoideae. Basidia 27-35 x 6.5-8 mµ, tetraspora. Cystidia desunt. Trama lamellarum parallela, fibulae praebens. Pagina pilei ex stratum hypharum in parte erectarum, laxarum, fibulatarum, incrustatarium constans.

PILEUS 4.5-6 cm, dark reddish brown (7F7), subhygrophanous and drying more fuscous (fuscous brown - 7F4), darkest at the center, fading somewhat to the margin, convex, becoming nearly plane, shallowly umbonate, margin even and almost straight; surface lubricous when wet, later dry, matte, almost fibrillar; context rather thick, up to 7 mm thick, pinkish cream, somewhat soft when drying;



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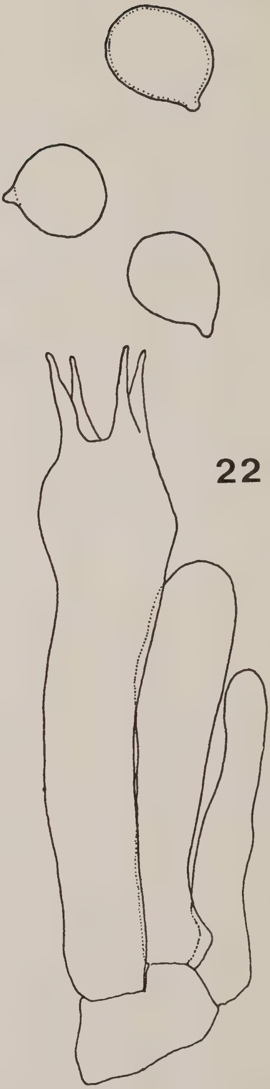


22

Figure 21. - Rhodocollybia oregonensis, W1736, basidia, spores, clamp; Figure 22. - Rhodocollybia maculata var, maculata, W1118, basidium and spores.

odor penetrating, like Vicks Vaporub or moldy cinnamon, taste not distinctive.

LAMELLAE white, unchanging and not staining ferruginous, narrowly adnexed, deeply sinuate-uncinate, blunt-ended both at the stipe and margin, thin and close, more or less 60 lamellae reaching the stipe, moderately broad, 25 x 5 mm, edges concolorous, even at first, later eroded and splitting transversely.

STIPE 8-10 cm long, 9-20 mm broad, light orange, pallid below substratum, equal in upper third, expanding and ventricose in the middle third, and tapering abruptly below this, buried for one-half the length; faintly powdery-pruinose at the apex, glabrous below, striate-grooved, grooves becoming deeper, wider and more numerous from the apex towards the base; not staining, stuffed, pale pinkish cream within, quite fibrous, splitting longitudinally rather readily, without rhizomorphs.

SPORES 6.5-7.5 x 3-4 µm, generally 6.5 x 3.5 µm, narrowly ovate to ellipsoid, thin-walled, smooth, dextrinoid; BASIDIA 27-35 x 6.5-8 µm, four-spored, noncarminophilous; no CHEILOCYSTIDIA differentiated, or if present, not exceeding the basidia and subclavate, PLEUROCYSTIDIA not differentiated; GILL TRAMA parallel, clamped, composed of hyphae 2-7 µm in diameter, nonamyloid; PILEAL SURFACE a layer of partially erect, loose, clamped hyphae 2-5 µm in diameter, encrusted with irregular dark spots, nonamyloid, overlying a more compact, somewhat more radial zone of hyphae 3-8 µm broad; CONTEXT interwoven, nonencrusted, nonamyloid, clamped, composed of hyphae 4-8 µm in diameter.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react very faintly with guaiacol, tincture of guaiac, phenol, and pheonl-aniline.

HABITAT: No data available.

MATERIAL STUDIED: WASHINGTON, King Co., W1717 (Seattle).

This species is distinctive by its dark blackish cap, white gills, light orange ventricose stipe, lack of any ferruginous stains, and dextrinoid ellipsoid spores.

26. Rhodocollybia maculata (Fr.) Singer. Schweiz Z. Pilk. 17:71. 1939

Figure 22 and 24; Plate VII

Basionym: Agaricus maculatus Fries, System. Mycol. 1:45. 1821.

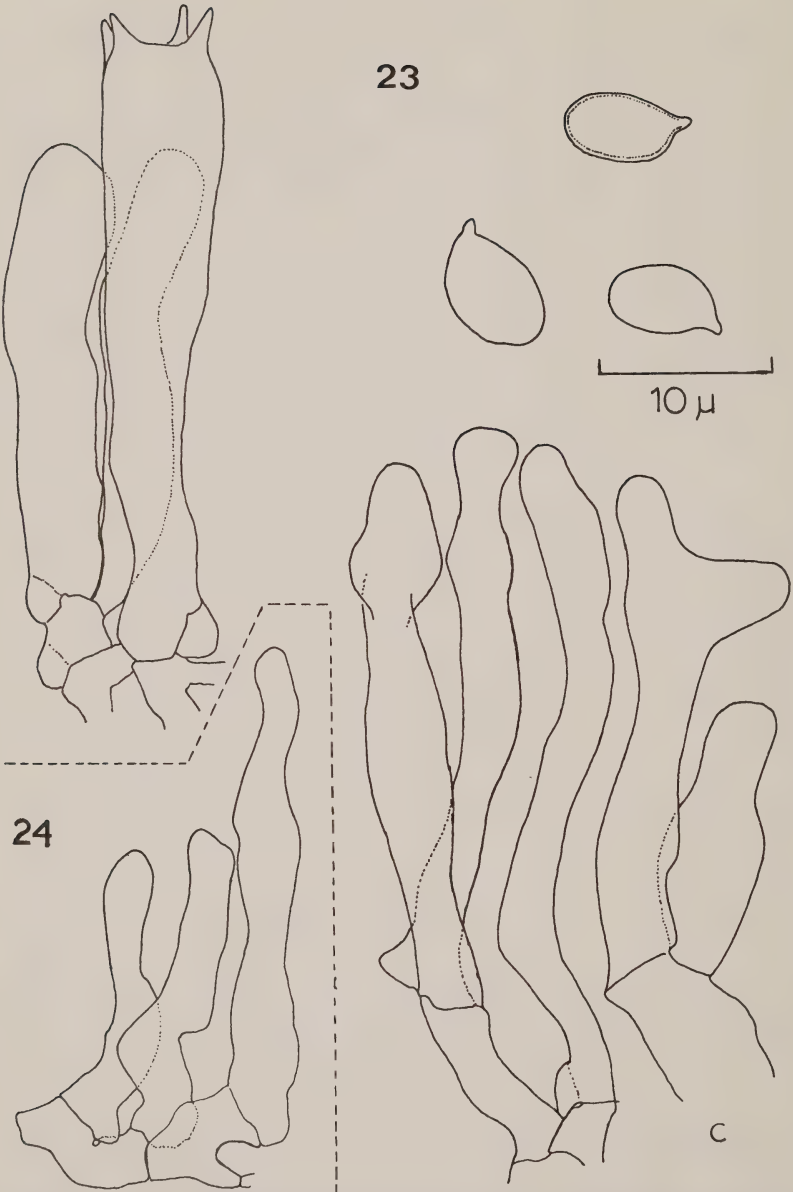


Figure 23. - Rhodocollybia maculata var. nigra, W971, basidium, spores, cheilocystidia (c); Figure 24. - Rhodocollybia maculata var. maculata, W1118, cheilocystidia.

Synonyms: *Agaricus carnosus* Curt. F. Lond. fasc. 5:71. 1777.
Gymnopus carnosus (Curt.) Murrill, N. Am. Flora 9(5):358. 1916.
Agaricus (*Tricholoma*) *limonium* Peck, Bull. Buffalo Soc. Nat. Sci. 1:43. 1873.
Collybia maculata (Fries) Quélet, Champ. Jura. Vosges. p. 330. 1873.
Illustrations: Sowerby, British Fungi, tab. 246 (*Agaricus carnosus*); Cooke, Illustr. Brit. Fungi, tab. 142; Britz, Hymenom., tab. 13, fig. 217; Lange, Flora Agaricina Danica, tab. 42, fig. c.; H. Romagnesi, Nouvel Atlas des Champignons, Pl. 106.

PILEUS 4-9 (12) cm broad; convex to obtuse, becoming plane, frequently margin is unevenly raised and the surface gently undulate, pallid to pale tan (4A3 to 5B4), occasionally darker over the disc, surface moist, neither truly hygrophanous or viscid, sublubricous in the moist condition, matte when drier, surface glabrous, stained faintly ferruginous in spots naturally or where bruised slowly; context very thick, generally deeper than the depth of the gills at their point of attachment, consistency rather brittle when moist, soft when drier; odor none or fungoid, taste bitter.

LAMELLAE white or pale pinkish buff, abruptly sinuate, appearing almost free at maturity, blunt-ended at the stipe, sharp-pointed at the margin, ventricose, thin and crowded, rather broad but generally not as broad as the context is thick, 6-9 mm x 17-23 mm, edges concolorous, often serrate at first, later becoming eroded and fraying, stained ferruginous, particularly along the edges or where bruised.

STIPE 4.2-10 cm long, 8-14 mm broad, white, later sordid whitish, especially in the lower half, narrowed gradually to the base, then subradicating and tapering abruptly in the substratum; base white-cottony-tomentose, upper portion evenly white pruinose, fibrillose or with a thin appressed tomentum, glabrescent and longitutinally striate in age; solid, concolorous within, rather firm but not tough, splitting easily longitudinally, sometimes flexuous towards the base.

SPORES 5-7 (8) x 4.5-6 (-6.5) µm, broadly ovate to globose, mostly subglobose, with a prominent apiculus, and a shallow suprahilar depression, small percentage dextrinoid, cream colored in heavy spore deposit; BASIDIA 33.37 x 7-8.5 µm, four-spored, noncarminophilous; CHEILOCYSTIDIA generally abundant but inconspicuous, rarely exceeding the basidia, 17-36 x 3-5 µm, narrowly clavate, somewhat pointed, never really filamentous, thin-walled, not encrusted; pleurocystidia not differentiated; PILEAL SURFACE a partially gelatinized, loosely interwoven layer of hyphae 2-3 µm in diameter, somewhat resembling a loose, irregular trichodermium, subtended by a more compact, interwoven mat composed of slightly larger hyphae (2.5-7 µm); context of hyphae 5-11 µm broad, clamped, nonamyloid, loosely interwoven.

MACROCHEMICAL REACTIONS: Pileal context and gills react positively but faintly with phenol, and ferric sulfate.

HABITAT: Scattered to gregarious on much decayed wood in dense coniferous woods.

MATERIAL STUDIED: WASHINGTON, Whatcom Co., W1118 (4th of July Pass, Panther Creek); King Co., W1093 (exact locality unknown); Pierce Co., W1438, W1669 (Dalles Campground); Clallam Co., W1403 (Altaire Camp); Jefferson Co., W1205 (Lower Lena Lake Trail), W1353 (along Hood Canal); OREGON, Portland, W. B. Gruber #766 (determined by Smith).

The spores in this description are somewhat larger than those Smith (1943) attributes to *Collybia maculata* var. *typica* (var. *maculata*). He states that the spores are #4.5-5.5 (6) x 3.5-4.5 (5) um, typically subglobose but varying either to globose or ellipsoid". Basically, the collections here studied did not differ in any other aspect but in spore size, and since the shape was the same, it did not seem that a new varietal name was necessary.

27. *Rhodocollybia maculata* var. *fulva* Lennox nom. nov.

Plate VIII

Pileus 1.7-2.7 cm latus, atrovinaceus, convexus, umbonatus, humidus dein siccus, glaber; lamellae albidae, adnexae, angustissimae, tenues, confertae, maculas ferrugineas praebentes; stipes 3.5-6.5 cm longus, 3-5 mm crassus, incarnatus, maculas ferrugineas evolvens, aequalis, haud radicatus; sporae 5.5-6.5 x 3.5-4.0 mµ, ovatae, dextrinoideae; cystidiola abundantes. Holotypus W1400, herbario Universatitis Washingtoni Conservatus.

PILEUS 1.7-2.7 cm, dark vinaceous red (7E8 or 7F7), subhygrophanous and drying to a light fuscous vinaceous (7F4 or 7F3), convex to conic, expanding somewhat, sharply umbonate, margin remaining slightly inrolled and even; surface at first moist, drying matte and unevenly, glabrous; context relatively thick over the disc (3 mm), tapering abruptly towards the margin, flesh-colored, firm and brittle, not tough; odor none, taste none.

LAMELLAE white, not changing color, narrowly adnexed, sinuate, narrow, 1.5 x 11 mm, thin and crowded, about 56 reaching the stipe, edge even and concolorous, conspicuously ferruginously spotted, linear.

STIPE 3.5-6.5 cm long, 3-5 mm broad, pallid to flesh-colored (6B3), especially in handling or when quite moist, hygrophanous, staining ferruginous, equal, striate-grooved at maturity, solid, terete, fluxuous, not radicate, with yellow and white rhizomorphs.

SPORES 5.5-6.5 x 3.5-4 µm, ovate, not varying to subglobose or ellipsoid, dextrinoid, thin-walled; BASIDIA about 28 x 8 µm, may be two-spored, noncarminophilous; CHEILOCYSTIDIA abundant, 22-35 (45) x 4-7 µm, ventricose-filamentose or clavate-contorted, generally not exceeding the basidia, thin-walled, not encrusted; no pleurocystidia differentiated; GILL TRAMA regular, parallel, clamped and nonamyloid; PILEAL SURFACE a partially gelatinized zone composed of loose, somewhat erect, more or less radial hyphae 2.5-4 µm in diameter, intergrading with a more compact, more interwoven layer of larger hyphae below 3-7 µm, surface hypahe spotted with a dark encrusted substance; CONTEXT predominantly interwoven, not encrusted, nonamyloid, clamped, composed of hyphae 4-12 µm in diameter.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react faintly with sulfoformol, and ferric sulfate.

HABITAT: Caespitose on wood.

MATERIAL STUDIED: WASHINGTON, Kittitas Co., W1400 (above Lake Kachess, Swans Lake Rd.).

This variety is easily distinguished by its small size, dark vinaceous brown cap with a rather prominent umbo, narrow white gills, ferruginous stains on gills and stipe, lack of any odor or taste, and ovate spores.

28. Rhodocollybia maculata var. nigra Lennox nom. nov.

Figure 23, Plate VIII

Pileus 2.7-4.0 cm latus, atrofuscus, immutabilis, humidus tum siccus, glaber, carne crassa, flavidula, odore fructoidea, fragranti, sapore amara; lamellae cremeae vel incarnato-aurantiacae, haud maculatae, emarginatae, angustatae et subdistantes; stipes 7-7.5 cm longus, 12-14 mm crassus, albidus, deorsum flavescens, glaber, striato-sulcatus, in dimidio inferiore radicans, supra atque infra terrarum angustatus; sporae 7-8.5 x 4.5-5.0 mµ, ellipsoideae, dextrinoideae; cystidiola inconspicua et dispersa. Holotypus W971, herbario Universatitis Washingtoni Conservatus.

PILEUS 2.7-4.0 cm, convex, becoming plane, neither depressed nor umbonate at maturity, dark brownish black (7F3 or 7F4), unchanging, shining when moist and also when dry, margin rather irregular and remaining somewhat inrolled, glabrous; context quite thick, as deep as the gills at the disc, solid, firm and rather tough, white or faintly yellowish; odor sweet, fruity, taste pleasant at first, becoming bitter.

LAMELLAE cream-colored to peach (5A4, no good match), unchanging, not staining ferruginous, emarginate, easily seceding, edges even but easily splitting, somewhat lighter than the faces, rather thick and subdistant, rather narrow, not more than 3 mm. broad.

STIPE 7-7.5 cm long, 12-14 mm broad, white, yellowing below (5A4); largest at the substrate level, tapering above and below this point, glabrous, striate-grooved at maturity, at least towards the base, dull and dry, solid above, stuffed below, concolorous within, buried for half the length in much decayed wood, bases confluent, bruising slightly and very slowly yellow, not staining ferruginous.

SPORES 7-8 (8.5) x 4.5-5 µm, ellipsoid, dextrinoid, BASIDIA 32-35 x 7-8 µm, four-spored; CHEILOCYSTIDIA inconspicuous, not exceeding the level of the basidia, 27-38 x 3.5-5.5 µm, thin-walled, clavate-contorted; PILEAL SURFACE a layer of partially erect, loosely interwoven, agglutinated hyphae 3-5 µm in diameter, spotted with a dark encrusting material, clamped, and nonamyloid.

MACROCHEMICAL REACTIONS: Carpophores negative to all reagents.

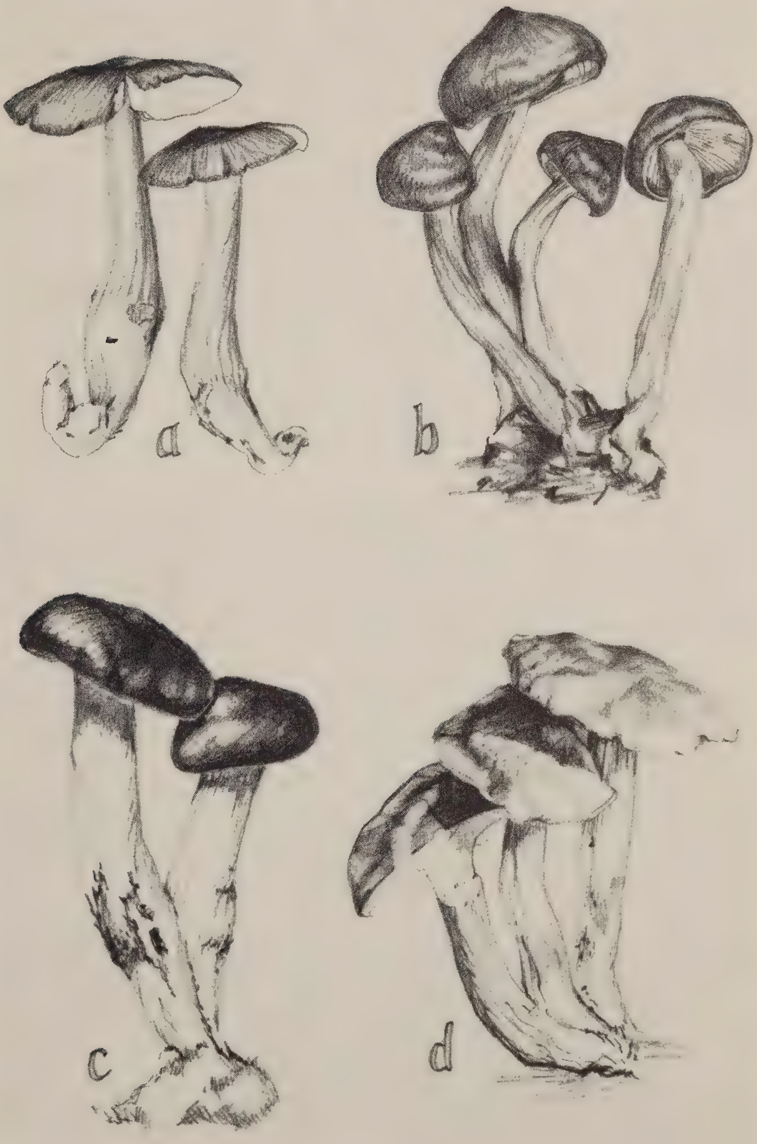
HABITAT: Caespitose on much decayed wood.

MATERIAL STUDIED: WASHINGTON, Pierce Co., W971 (Dalles Campground).

This variety is distinguished by its rather small size, dark blackish cap, narrow, yellow gills, sulcate rooting stipe, bitter taste, lack of ferruginous stains, and ellipsoid spores.

PLATE VIII -; a - Rhodocollybia subnigra, W1717, x ½; b - Rhodocollybia maculata var. fulva, W1400, x 1; c - Rhodocollybia maculata var. nigra, W971, x 3/4; d - Rhodocollybia maculata var. occidentalis, W1179, x ½.

VIII



29. Rhodocollybia maculata var. scorzonerea (Fr.) Lennox comb. nov.

Figure 25

Basionym: Agaricus maculatus var. scorzonereus Fries, Hymenom. Europael, p. 113. 1874.

Synonym: Collybia maculata var. scorzonerea (Fr.) Gillet, Champ. Fr., p. 315. 1878.

PILEUS 3.5-12 (15) cm broad, convex with the margin strongly inrolled, becoming plane at maturity, and frequently straight or slightly recurved, either depressed or umbonate, surface often shallowly undulate; pale buff (5A4 to 5A2) on the margin, darkening gradually to fulvous (6B6 to 5B5), occasionally with more yellowish colors, darkening somewhat with age, drying lighter, pale buff to a light yellowish buff (5A3 to 4A4), not really hygrophanous, with scattered circular watery spots and ferruginous stains; surface when moist nearly lubricous, not truly viscid, glabrous; context thick, reaching 1.5 cm, firm when moist, rather soft when drier, not pliant or tough, pale buff to yellowish; odor faint and somewhat fragrant, taste bitterish, sometimes delayed.

LAMELLAE yellowish or soon becoming so (4A5 or 4A6), narrow, 2-14 mm broad, generally less than 5 mm, very thin and crowded, 65-88 lamellae reaching the stipe, 2-4 tiers of lamellulae, narrowly adnexed, sinuate-uncinate, not ventricose, pointed both at the cap margin and stipe, edges concolorous and even to slightly eroded, sometimes stained ferruginous.

STIPE 3.5-17 cm long, 6-40 mm broad, pallid at the apex, darkening slightly below or with age to the color of the cap or more yellow, staining ferruginous, especially at the base; equal or more frequently widest in the medial region and tapering both above and below this point; faintly powdery-pruinose at first, glabrescent and markedly longitudinally sulcate-striate at maturity; often subradicate, flexuous, compressed or terete, hollow to stuffed, concolorous to yellowish within, fibrous-tough, but easily splitting longitudinally, with or without rhizomorphs.

SPORES 7-8.5 x 4-5.5 µm, ovate to ellipsoid, dextrinoid, smooth, creamy pink in heavy deposit; BASIDIA 26-37 x 6-8 µm, four-spored; CHEILOCYSTIDIA not strikingly different from basidia, sometimes abundant, often scattered, 16-36 x 3-5 µm, clavate-contorted; remaining microscopic characters as in R. maculata var. maculata.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react faintly with phenol, phenol-aniline, and ferric sulfate.

HABITAT: Scattered on much decayed coniferous wood in dense coniferous stands.

MATERIAL STUDIED: WASHINGTON, W1364 (locality unknown); King Co., W881 (Soda Springs); Whatcom Co., W196 (Baker River Trail); OREGON, Hood River Co., Smith 23636 (East Fork Salmon River); IDAHO, Bonner Co., W965 (Bindarch Creek).

This variety is easily distinguished by its yellow, rather narrow gills, ferruginous stains, yellowish to reddish tones of the mature cap and stipe, and the ellipsoid spores.

30. _Rhodocollybia_ _maculata_ var. _immutabilis_ (Smith) Lennox comb. nov.

Basionym: _Collybia_ _maculata_ var. _immutabilis_ Smith
Lloydia, _Vol. 6(4):260. 1943._

PILEUS 2.5-3.2 cm, pale greyish cream (4A2 to 4C3, no good match); convex, expanding to nearly plane, margin straight and even, surface appearing slightly powdery at first, neither hygrophanous nor changing color in age, context relatively thin, less than the depth of the gills, firm, not pliant, concolorous, odor faint and sweet, taste, none or mild.

LAMELLAE concolorous with the cap or slightly lighter (3A2 or 3B2, no good match), broadly adnate, emarginate-uncinate, thick, somewhat waxy and subdistant, ventricose, edges even and concolorous, not becoming eroded, not staining ferruginous.

STIPE 3.5-5 cm long, 5-10 mm broad, concolorous with the cap or somewhat darker (3C3), not staining in any part, tapering upward, surface streaked-striate, not really sulcate, with a basal white appressed tomentum; hollow and rather tough-fibrous, not at all pliant.

SPORES 6.5-8 x 4-4.5 µm, ovate to ellipsoid, dextrinoid, thin-walled, and smooth; BASIDIA 27-33 x 6.5-7.5 µm, four-spored, noncarminophilous; no cheilocystidia or pleurocystidia differentiated; remaining characteristics as in _R_. _maculata_ var. _maculata_.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react faintly with alpha-napthol, phenol, and phenol-aniline.

HABITAT: Gregarious on conifer duff in dense coniferous woods.

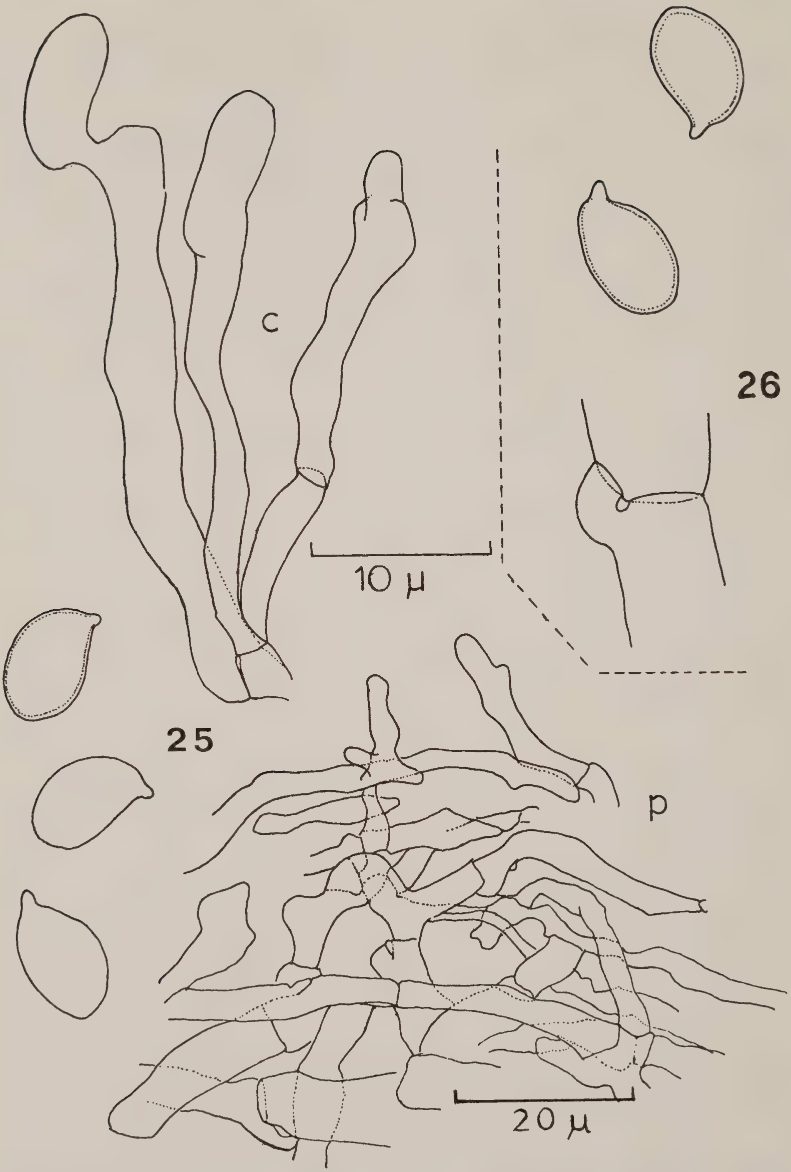


Figure 25. - Rhodocollybia maculata var. scorzonerea, W1364 spores, cheilocystidia (c), pileal surface (p); Figure 26. - Rhodocollybia maculata var. occidentalis, W1754, spores and clamps.

MATERIAL STUDIED: WASHINGTON, King Co., W633 (near Stevens Pass).

The above mentioned collection, upon which this description is based, matches most of the characters of *R. maculata* but lacks any ferruginous stain and has ellipsoid rather than globose spores, and in consideration of the latter characters best matches var. *immaculata*. The collection however was rather uncharacteristic in regards to its relatively small size and lack of a sulcate stipe. It may be either depauperate or truly distinct from the var. *immaculata*, but these differences did not seem to warrant the creation of a new variety without studying further material.

31. *Rhodocollybia maculata* var. *occidentalis* (Smith) Lennox comb. nov.

Figure 26, Plate VIII

Basionym: *Collybia maculata* var. *occidentalis* Smith, Lloydia Vol. 6(4):258. 1943.

PILEUS 2.6-11 cm broad, convex with an inrolled margin, becoming nearly plane, surface sometimes shallowly undulate; whitish or with a pale pinkish or buff tinge (5A2 or 5A4), generally darkening with age, becoming dark fulvous at the center, fading gradually to a warm buff at the margin (6D7 to 6C6 to 5A4 at the margin), becoming reddish spotted; surface faintly hoary or canescent at first, moist and dull, not viscid; context concolorous, thick over the disc, 0.5 cm or more, tapering abruptly near the margin, sometimes revolute or frayed at the extreme margin; odor rather faint, pleasant and aromatic or fruity, taste mild to faintly farinaceous.

LAMELLAE whitish to pale orange (5A4), emarginate to sinuate-uncinate, thin and rather waxy, crowded, 80-100 lamellae reaching the stipe, rather broad but generally not as broad as the context is deep, 3-8 mm x 15-37 mm, edge concolorous and at first even, later eroded.

STIPE 4.3-15 cm long, 8-21 mm broad, whitish or pale buff (5A2), staining ferruginous in the lower half; equal or ventricose at the substrate level and then tapered abruptly into a short pseudorhiza; surface at first faintly powdery-pruinose, glabrescent, and conspicuously longitudinally sulcate-striate later, solid at first, later hollow in the upper portions, often compressed or shallowly furrowed at maturity, flexuous at the base.

SPORES 6.5-11 x 4-6 µm, narrowly ovate to ellipsoid, thin-walled, dextrinoid, cream colored to pale peach in heavy deposit; CHEILOCYSTIDIA not differentiated; remainder of characteristics as in the description of *R. maculata* var. *maculata*.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react positively with phenol, phenol-aniline, and ferric sulfate.

HABITAT: Gregarious to caespitose in thick humus or on much decayed wood in conifer forests.

MATERIAL STUDIED: WASHINGTON, W1179 (no location); Chelan Co., W1372 (Lake Wenatchee); Snohomish Co., W1152 (4 mi. up N. Fk. Sauk River); Thurston Co., W495 (near Olympia); Pierce Co., Smith 29006 (Longmire, Mt. Rainier Ntl. Pk.); Skamania Co., W1440 (Cispus Camp).

This variety differs from variety *maculata* in the slightly but consistently larger, more ellipsoid spores, lack of a bitter taste, the somewhat less crowded broader gills, and in the presence generally of a pinkish blush on the immature caps.

Section *Butyracea* (Singer) Lennox stat. nov.

Basionym: *Collybia*, Section *Stripedes*, Stirps *Butyracea* Singer. Agar. in Mod. Tax. 1962.

Type species: *Rhodocollybia butyracea* (Fr.) Lennox

PILEUS rather large, 3-7 cm, generally not more than 5 cm, light bay-colored to vinaceous brown, hygrophanous and changing color, context rather thick over the disc, generally 5 mm or less, but not as deep as the gills are broad; gills white; stipe glabrous, neither striate-sulcate, nor subradicating in decayed wood; rarely stained ferruginous in any part; scattered to gregarious on conifer duff, occasionally on much decayed conifer wood.

Key to the Species

1. Cap deep fulvous to dark vinaceous brown when moist, fading to light fulvous in drying................. 2.
1. Cap buff to warm tan or light fulvous, hygrophanous and drying only slightly lighter, changing from reddish hues to more greyish ones................. .... *R. butyracea* (p. 219)
    2. Spores ellipsoid to capsule-shaped, (6.5) 7-10 (11.5) x 3-4.5 µm, carpophores react rapidly with PDAB to give a magenta color to the solution. .... *R. extuberans* (p. 222)

2. Spores globose to very broadly ovate, 3.5-5.5 x 3-4.5 µm, gills react weakly and slowly to PDAB (faint pink)....... R. badiialba (p. 224)

32. Rhodocollybia butyracea (Bull. ex. Fr.) Lennox com. nov.

Figure 27, Plate IX

Basionym: Agaricus butyraceus Fries. System Mycol., 1:121. 1821.
Synonyms: Collybia butyracea (Bull. ex Fr.) Quélet. Champ Jura Vosges p. 93. 1872.
Gymnopus butyraceus (Bull. ex Fr.) Murrill. Mycol., 30:366. 1938.
Illustrations: Michael, Fuhrer f. Pilzfreunde (1927), Vol. I, no. 40; Cooke, Illustr. Brit. Hymenom., Pl. 189; Gillet, Champignons de France, No. 149.

PILEUS 2.7-7.0 cm broad, buff to a warm tan to light fulvous, (7F8 to 5B3), generally darker on the disc and fading towards the margin, occasionally pallid on the disc and uniformly buff elsewhere, hygrophanous and drying only slightly lighter, changing from reddish hues to more grey ones, sometimes becoming more yellowish over the disc (4B3 to 5C5/5C6 on margin); convex to conic, becoming plane, with a prominent broad umbo at maturity, margin generally becoming straight, even or sometimes fraying or lobed with age; surface glabrous, lubricous and shining at first, later dull-matte in drying; context watery-moist and then concolorous, soft, thick, up to 4 mm over the disc; taste and odor mild, fungoid or not distinctive.

LAMELLAE white with a faint pinkish or cream cast, becoming yellowish in drying, sinuate uncinate, easily seceding, blunt-ended at the stipe, rather pointed towards the margin, ventricose, thin, crowded, 48-60 lamellae reaching stipe, 5 tiers, broad, 11-27 mm x 3.5-5 mm, edge even or finely serrate at first, later strongly eroded and somewhat lighter, consistency soft.

STIPE 5-9 cm long, 5-12 mm broad, pallid or tan throughout (5A3 to 5B3), sometimes slightly darker towards the base, deep tan (5D5), subhygrophanous, conic-attentuated upwards, flexuous, subbulbous at the base, striate-grooved, subshining when moist, glabrous, short, white matted-tomentose at the base; hollow and the cuticle rigid-cartilaginous, twisted longitudinally, easily fraying, fibrous, terete or compressed.

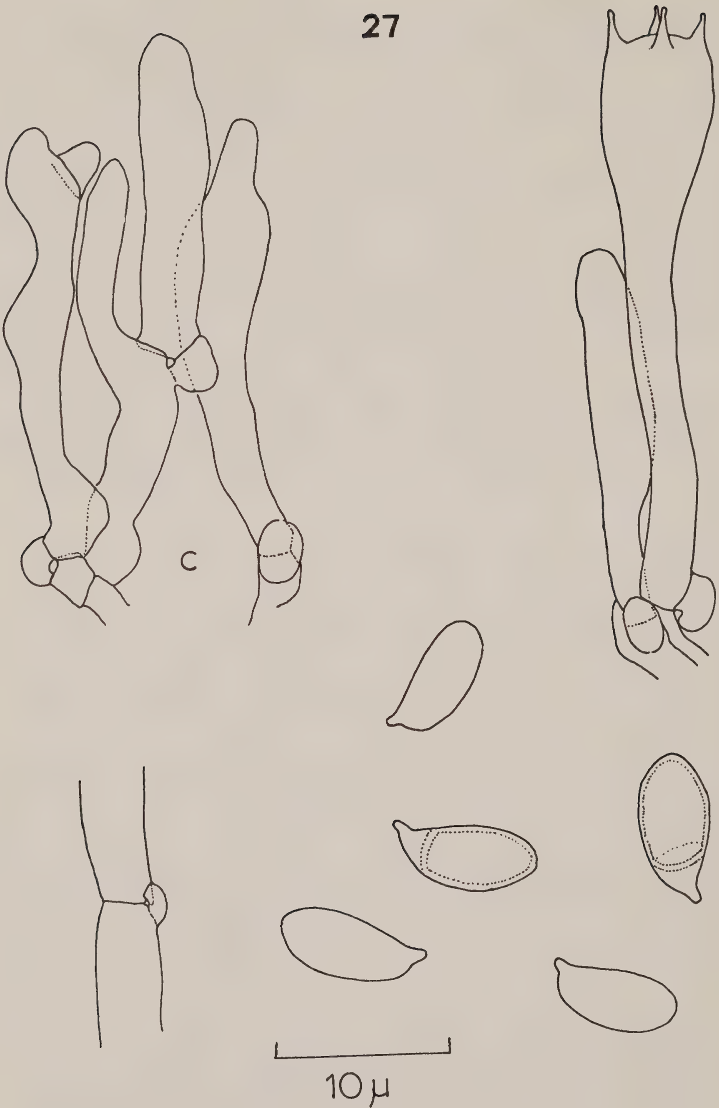


Figure 27. - Rhodocollybia butyracea, W1017, basidium, spores, clamp, cheilocystidia (c).

SPORES 6.5-9 (11) x 3.0-4.5 µm, narrowly ellipsoid to capsule shaped or ovate, smooth, the exosporium very thin, the endosporium thick (1 µm) and dextrinoid with Melzer's, often retracted from the apicular end, cream to light orange in deposit (5A3); BASIDIA 27-35 x 6-7.5 µm, narrow and expanded abruptly in the upper third, basidioles quite slender and unexpanded, four-spored, a few with the endosporium contracted into the upper or lower half of the basidia, much thickened and dextrinoid; CHEILOCYSTIDIA clavate somewhat distorted or irregular in shape, not branched or septate, not filamentous, scattered, very inconspicuous and not exceeding the basidia; pleurocystidia not differentiated; PILEAL SURFACE a cutis of compact, radial to somewhat interwoven narrow hyphae, 2-5 µm in diameter, in a zone 50-70 µm deep, the upper cells partially gelatinized and agglutinating the hyphae, scattered hyphae with banded encrustations, nonamyloid, no pileocystidia; CONTEXTUAL HYPHAE much less compact and larger than those of the surface layers, 5-25 µm in diameter, predominantly interwoven, very thin-walled and readily collapsing, clamped, nonamyloid, with scattered encrusted hyphae; GILL TRAMA parallel, composed of hyphae 4-5 µm broad, thin-walled, nonamyloid, subhymenium interwoven, rather coarse, and narrow.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react positively with aniline (faint, yellow to pinkish), alpha-napthol, guaiacol, tincture of guaiac (faint, variable - sometimes negative), phenol, and phenol-aniline.

HABITAT: Scattered to loosely caespitose in thick duff or conifer forests.

MATERIAL STUDIED: WASHINGTON, Whatcom Co., W323 (Mosquito Lk.); King Co., W184 (Arborteum, Seattle), W237 (McClellans Butte), W403 (St. Thomas and St. Edward Seminary Woods), W413 (Water Main Woods); Thurston Co., W499, W593, W594, W982, W1041, W1239, W1240, W1241, W1102, W1535, (Tenino Mounds, near Olympia); Clallam Co., W1143 (Heart O' the Hills, Olympic Ntl. Pk.); Jefferson Co., W526 (Enchanted Valley, Olympic Ntl. Pk.).

R. butyracea is distinguished from other closely related species by the following set of characteristics: strongly reactive in the macrochemical spot tests, a light orange spore print, white to cream gills with a strongly serrate or eroded margin and ventricose broad shape, an umbonate cap which is markedly lubricous and changes from a reddish tan to a greyish tan in drying, a striate-grooved stipe with a subbulbous base, and in general, a soft nonreviving consistency throughout the carpophores.

33. Rhodocollybia extuberans (Fries) Lennox comb. nov.

Figure 28, Plate IX

Basionym: Agaricus extuberans Fries, Epicrisis System. Mycol.:93. 1838.
Synonym: Collybia extuberans (Fries) Quélet. Champ. Jura Vosges p. 97. 1872.
Illustrations: Fries, Icones Hymenon., tab. 67, fig. 1; Battarra, Fung. Arimin. Historia, tab. 28, fig. A; Britz., Hymenon., tab. 47, fig. 320; Cooke, Illustr. Brit. Fungi, pl. 202. (as Agaricus nitellinus).

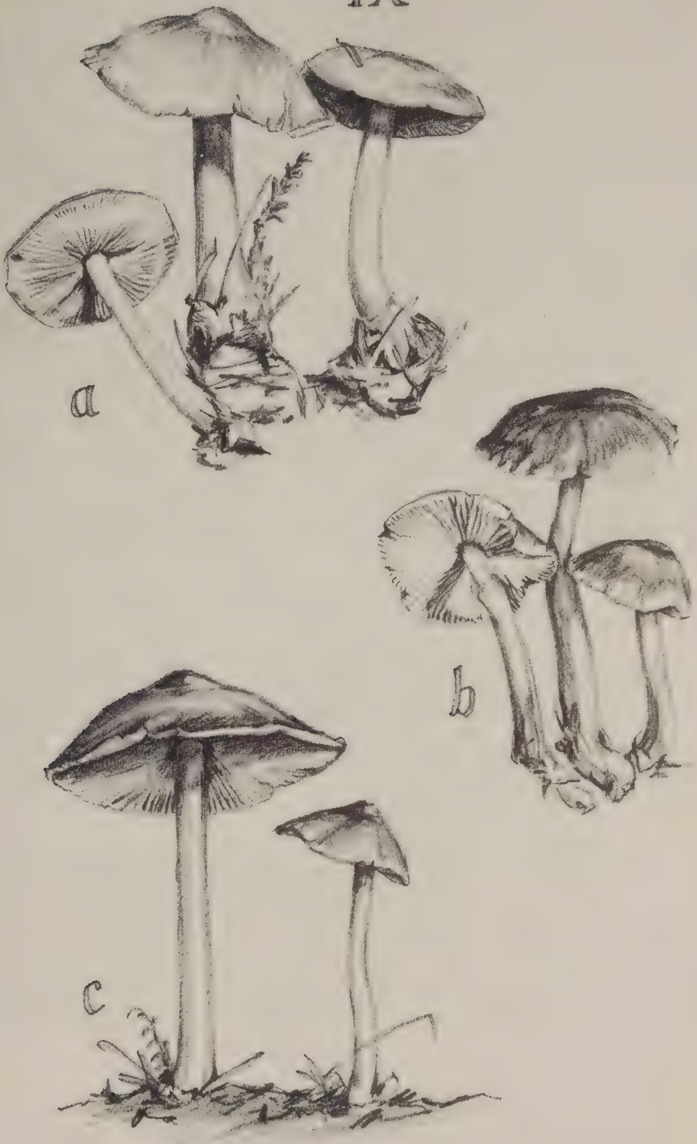
PILEUS 2-5.5 cm broad, dark vinaceous brown on the disc to a deep fulvous on the margin (8F7 to 6D7 or 6E7), hygrophanous and fading to a light fulvous, remaining darker on the disc; convex to conic, becoming broadly conic-campanulate or plane with a low or prominent conic umbo, margin remaining somewhat inrolled or becoming straight and recurved; surface subviscid to lubricous when moist, drying dull and finely radially wrinkled, and obscurely fibrillose at the margin, glabrous elsewhere, occasionally moist-striatulate at the extreme margin; context rather thick, 5-8 mm, very sordid reddish brown near the pellicle, watery-translucent below when moist, later pallid, firm, fibrous-tough; odor faint, sweet, "soapy"; taste none.

LAMELLAE white or a very pale yellow in old specimens, yellowing in drying; deeply sinuate, almost free, sharp-pointed at the margin, blunt-ended at the stipe, somewhat ventricose, thin, close to crowded, 40-50 lamellae reaching stipe, 4 tiers, moderately broad, 15-22 x 4-5 mm, edge even or very finely serrate when immature, becoming serrate to strongly eroded later, consistency rather soft, becoming spotted with very sordid brownish spots.

STIPE 3.5-8 cm long, 3-20 mm broad, concolorous with the margin of the mature cap (6E7), somewhat lighter at the apex (6A2, flesh-colored), uniformly colored or darkening somewhat downward; more or less tapering at the base to a pseudorhiza-like prolongation which is buried in the substratum, generally rather markedly expanded above this and subbulbous, surface powdery-pruinose to hoary-pubescent at the apex when young, glabrescent, strongly striate-grooved the entire length, matted-tomentose below substratum; hollow to stuffed with a thin rind, fibrous, easily splitting, terete or compressed, flexuous, twisted, with or without abundant white rhizomorphs.

PLATE IX -; a - Rhodocollybia butyracea, W982, x 3/4; b - Rhodocollybia extuberans, W1172, x ½; c - Rhodocollybia badiialba, W1626, x 3/4.

IX



SPORES (6.5) 7-10 (11.5) x 3-4.5 µm, ovate to narrowly ellipsoid, very thin-walled to rather thick-walled, hyaline, endosporium dextrinoid and frequently retracted from the apicular end, cream to pale orange in thick deposit, becoming quite yellow with age; BASIDIA 23-35 x 6-7 µm, rather long, narrow through most of length, expanded just at apex; a very few with dextrinoid and retracted endosporium, appearing thick-walled and septate, four-spored with an occasional scattered two-spored basidium; CHEILOCYSTIDIA sometimes differentiated, scattered and very inconspicuous, clavate or subclavate, contorted, or septate, hyaline, thin-walled, not exceeding the basidia, 21-35 x 4-5.5 µm; no pleurocystidia differentiated; PILEAL SURFACE a cutis of radially arranged, narrow hyphae 2-4 µm in diameter, encrusted with conspicuous transverse bands of dark brownish pigment, in a compact layer 3-5 hyphae deep, intergrading with tissue of context in size and density of cells; CONTEXTUAL HYPHAE 3-6 µm in diameter, rather loose, radially arranged, clamped, nonamyloid; GILL TRAMA composed of parallel cylindric hyphae 4-8 µm in diameter, clamped, nonamyloid, subhymenium very thin and ramose.

MACROCHEMICAL REAGENTS: Gills and flesh of the cap react positively with alpha-napthol, guaiacol, tincture of guaiac, phenol, phenol-aniline, and PDAB (dark, rapid reaction - immediate to 5 minutes - solution turns a dark magenta).

HABITAT: Gregarious to caespitose on well decayed conifer wood, in dense moist woods.

MATERIAL STUDIED: WASHINGTON, Clallam Co., Smith 16967 (Lake Angles Trail), Smith 17800 (Olympic Hot Springs); Jefferson Co., W1172 (Dosewallips Campground); Gray's Harbor Co., Kauffman, Oct. 14, 1925 (Lake Quinault); Skagit Co., W1694A (Mineral Park); King Co., Stuntz 1012 (Campus, Univ. of Wash.); Thurston Co., W1268 (Tenino Mounds); IDAHO; Bonner Co., W918 (Priest River Experimental Station).

This species is distinguished from R. badiialba by its ellipsoid, dextrinoid spores, encrusted pileal surface which is not gelatinized, cheilocystidia, sweet odor and absence of a bitter taste, and the rapid reaction with PDAB to yield a bright magenta color to the solution. I do not agree with Smith (1944) that the colors of the cap are duller and not as red as those of R. badiialba; however, he is generally correct in stating that the gills of R. extuberans are less crowded and the stipe subradicating.

34. Rhodocollybia badiialba (Murrill) Lennox comb. nov.

Figure 29, Plate IX

28

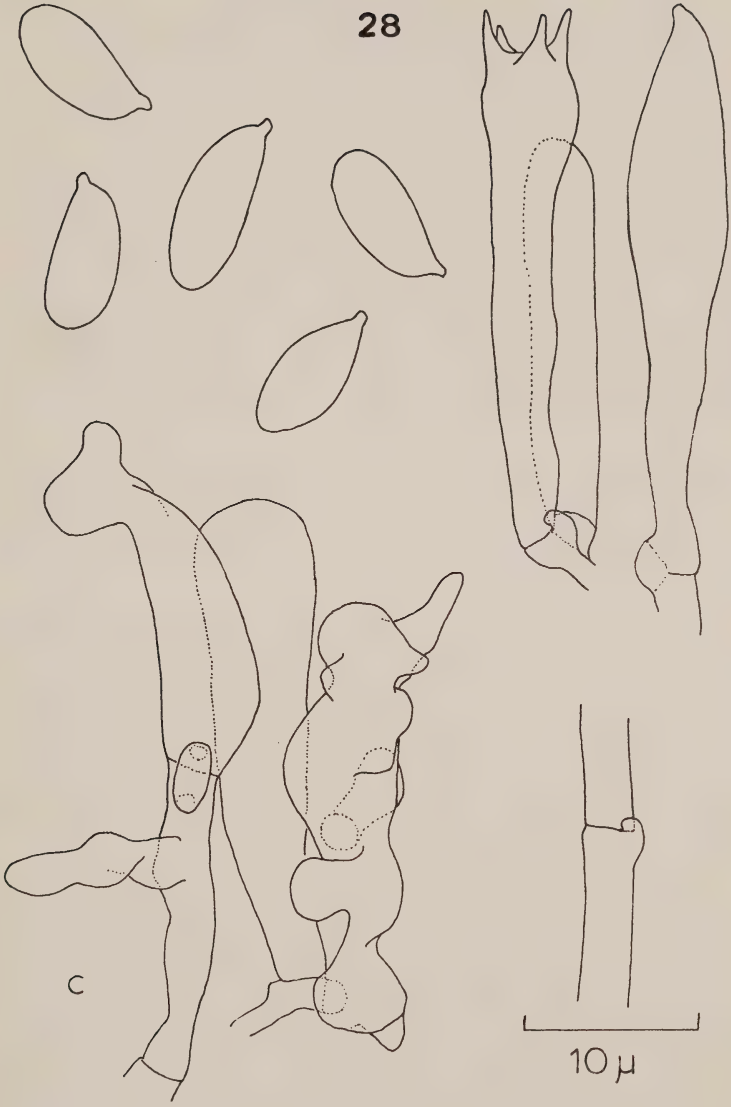


Figure 28. - Rhodocollybia extuberans, W1172, basidium, spores, clamp, cheilocystidia (c).

Basionym: *Gymnopus badiialbus* Murrill. N. Amer. Flora.
Vol. 9:369. 1916.
Synonym: *Collybia badiialba* (Murrill) Murrill.
Mycol. Vol. 8:218. 1916.
Illustrations: A. H. Smith, Studies of N. Am. Agarics
I. Contr. of the Univ. of Mich. Herb. No.
5 Feb. 1941. Pl. II.

PILEUS 2.4-11.5 cm, generally 5-7 cm, dark chestnut (8F6 to 7D6) or dark fulvous on the disc, fading somewhat to the margin, vinaceous brown to fulvous (7D6 to 6B4), sometimes spotted vinaceous, hygrophanous and changing to a dark warm buff (6C4); convex, becoming plane, with a broad shallow umbo, margin becoming straight, frequently fraying with age, sometimes revolute as well; surface glabrous, very lubricous, not viscid, obscurely fibrillose when quite wet, occasionally undulate, matte in drying; context rather thick, up to 9 mm, white to tan, soft, rather brittle when moist; odor faint, fungoid to pungent, taste slowly becoming unpleasant and bitter.

LAMELLAE white, not changing with age, yellowing in drying, narrowly adnexed, sinuate-uncinate, sharply pointed at the margin, blunt-ended at the stipe, ventricose, broad, 2-4.5 cm x 3-8 mm, crowded, 50-80 lamellae reaching stipe, 4 tiers of lamellulae, thin, edges concolorous and serrate when young, later eroded.

STIPE 5-11 cm long, 5-9 mm broad, pallid pinkish grey at the apex, flesh-colored (5A3, no good match), darkening slowly downward to a light vinaceous tan (6D5), staining reddish brown as in *R. maculata*, slightly expanded at extreme apex, generally equal below this, sometimes tapering upward, often abruptly tapered in the last two cm of base, appearing to root somewhat then; surface at the apex powdery-pruinose, then glabrescent, striate-grooved for the entire length; hollow, ridgid and strict, terete or compressed, fibrous, concolorous within when water-soaked, with abundant white rhizomorphs.

SPORES 3.5-5.5 x 3-4.5 µm, a few sometimes 8 x 5 µm, globose to very broadly ovate, very thin-walled to thick-walled (1 µm), smooth, hyaline, with dextrinoid endosporium (percentage of reacting spores differs widely), the endosporium often retracting from the apicular end, cream to light orange in deposit; BASIDIA 21-25 x 4-5.5 µm, most rather slender, four-spored predominantly, some two-spored basidia, a few dextrinoid basidia with the staining endosporium retracted into either lower or upper half, appearing septate, thick-walled; basidioles slender at the apex, subventricose towards the base; CHEILOCYSTIDIA not differentiated; PILEAL SURFACE a partially gelatinized cutis composed of hyphae 2-10 µm in diameter, nonencrusted, in a zone up to 85 µm deep, radially oriented, overlying a more compact zone of hyphae of the same diameter, this layer

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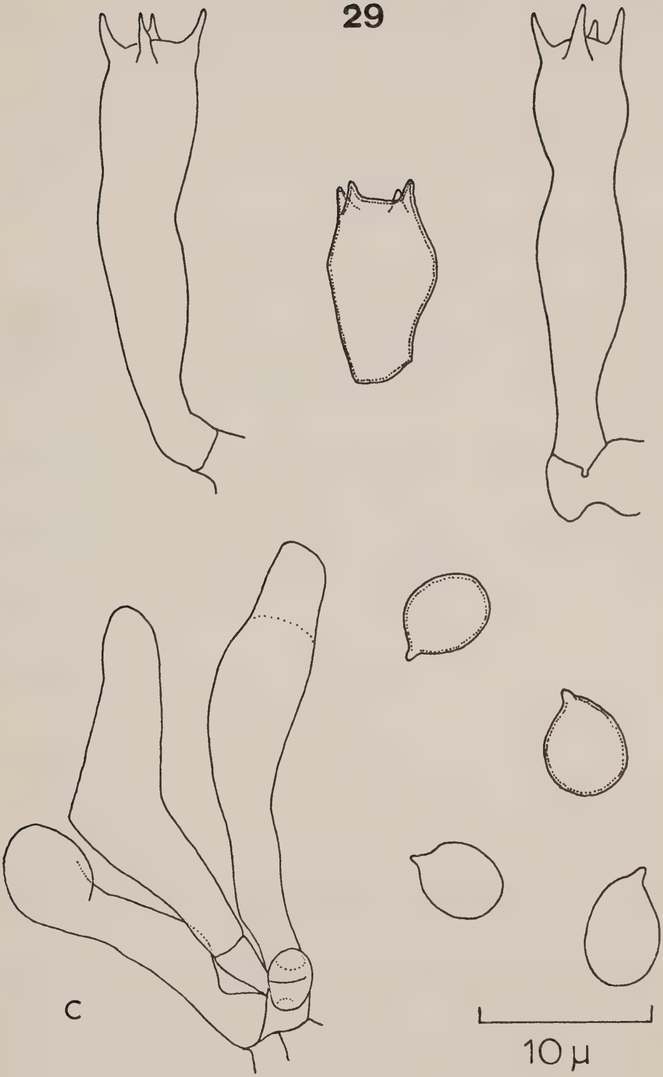

Figure 29. Rhodocollybia badiialba, W547, basidia, spores, cystidioles (c).

intergrading into the contextual hyphae; CONTEXT partially interwoven, rather loose, of large diameter hyphae, 5-15 µm broad, clamped, nonamyloid; GILL TRAMA of coarse hyphae 8-16 µm in diameter, clamped, subhymenium rather narrow and tightly interwoven.

MACROCHEMICAL REACTIONS: Gills and flesh of the cap react positively with tincture of guaiac, and phenol. Reactions occurred with alpha-napthol, guaiacol, and phenol-aniline which were sporadic and faint.

HABITAT: Gregarious to loosely caespitose on much decayed logs or thick duff, in dense conifer woods.

MATERIAL STUDIED: WASHINGTON, San Juan Co., W1072 (Friday Harbor Biological Station); King Co., W101 (St. Thomas and St. Edward Seminary Woods), W1625 (Hamilin Park), W1628 (residence, Seattle); W532 (Woodinville), W. A. Murrill 611 (Type - Seattle); Skamania Co., W1444 (Cispus Training Camp); W1059 (locality unknown).

This species is distinguished from R. extuberans, to which it is most closely related, by the relative inactivity with macro-chemical spot reagents, the absence of cheilocystidia, the presence of globose spores, the absence of encrusted hyphae on the cuticle, the gelatinized upper layer of the pileus, the darker, more vinaceous colors of the cap, and a bitter taste.

COLLYBIA (Fr.) Staude, Schwamme Mitteldeutschl. p. xxviii. 1857.

Type species: Agaricus dryophilus. Bull. Herb. Fr. pl. 434. 1789.

HABIT collybioid, PILEUS generally small, convex, becoming plane, rarely either unbilicate or umbonate; white, tan, or fuscous shades, never really brightly colored, context generally rather thin, 3 mm or less, taste and odor usually not distinctive.

LAMELLAE white to pale grey or tan, narrowly to broadly adnate, occasionally appearing subdecurrent at maturity, edges usually even and concolorous.

STIPE generally white or concolorous, equal or somewhat larger at the base or apex, usually glabrous, often with a whitish tomentum at the base, or occasionally tomentose the entire length, hollow to stuffed, neither truely radicate nor with a sclerotium.

SPORES globose to ellipsoid, thin-walled, smooth, nonamyloid, white in deposit; BASIDIA four-spored; pleurocystidia not differentiated, CHEILOCYSTIDIA generally not differentiated, if present, clavate-contorted, thin-walled, not encrusted, and not exceeding the basidia; PILEAL SURFACE a cutis of radial, narrow repent hyphae, or undifferentiated from the context, composed of rather coarse, interwoven hyphae; context radial to interwoven; GILL TRAMA regular, parallel or somewhat interwoven centrally, clamped, nonamyloid.

ACKNOWLEDGEMENTS

I am grateful to Dr. Alexander H. Smith, University of Michigan, and Dr. Daniel E. Stuntz of the University of Washington for the use of the herbaria, personal collections, and field notes. Numerous collections and type specimens were kindly made available on loan from the following institutions and individuals: New York Botanical Garden and Dr. C. T. Rogerson, New York State Museum and Dr. J. H. Haines, University of Michigan Herbarium and Drs. A. H. Smith and R. L. Shaffer. I would also like to thank Dr. Fred Van deBogart, Dr. Dave Hosford, and Susan Libonatti-Barnes for their comments in the preparation of this manuscript. Special thanks is due Dr. Daniel Stuntz whose patience, encouragement, and expertise made this study possible.

BIBLIOGRAPHY

Arnold, Jean. 1935, A comparative study of certain species of Marasmius and Collybia in culture. Mycologia 27: 388-417.

Bigelow, H. 1973. The genus Clitocybula. Mycologia 65: 1101-1116.

Fayod, M. V. 1889. Prodrome d'une Histoire Naturelle des Agaricines. Annales des Sciences Naturelles, 7, Serie. Botanique 9: 181-411.

Fries, E. M. 1821. Systema Mycologicum. Vol. I. Berling. Lund. 520 p.

______________. 1838. Epicrisis Sytematis Mycologici. Gleerup. Lund. 610 p.

Karsten, P. A. 1879. Hymenomycetes Fennici. Acta Soc. Fauna Pl. Fenn. 2(1): 140 p.

______________. 1882. Hattsvampar. Helsinki, Finland.

______________. 1891. Symbolae ad Mycologiam Fennicam. Medd Soc. Fauna Fl. Fenn. 18: 61-68.

Konrad, P. and A. Maublanc. 1932. Icones Sectorum. Vol. 3: pl. 200-211.

Kornerup, A. and J. H. Wanscher. 1966. Color Atlas. Reinhold. Copenhagen, Denmark.

Kuhner, R. and H. Romagnesi. 1953. Flore Analytique des Champignons Superieurs. Masson et cie Paris. 556 p.

Kummer, P. 1871. Der Fuhrer in Die Pilzkunde. Zerbst. 146 p.

Lange, J. 1936. Flora Agaricina Danica Vol. III Recato, Copenhagen.

Metrod, G. 1952. Les Collybies. Rev. Mycol. 17(1): 60-93.

Moser, M. 1967. Die Rohrlinge und Blatterpilze, in Gams, H., Kleine Kryptogamenflora II. Stuttgart, Gustav-Fischer Verlag.

Patouillard, N. 1900. Essai Taxonomique des Hymenomycetes. L. Declume, Lons-Le-Saunier. 184 p.

Quélet, L. 1872. Les Champignons de Jura et des Vosges. Mem. Soc. Emul. Montbeliard, ser II, 5: 43-332.

Ridgway, R. 1912. Color Standards and Color Nomenclature. Publ. by the author. Washington, D. C.

Singer, R. 1936. Das System der Agaricales. Ann Mycol. 34: 286-378.

______________. 1938. Notes sur quelques Basidiomycetes. Rev. Mycol. 3: 187-199.

______________. 1944. New genera of fungi - I. Mycologia 36: 358-368.

______________. 1949 (publ. 1951). The Agaricales in Modern Taxonomy. Lilloa 22: 1-832.

______________. 1962. New genera of fungi VII. Persoonia 2: 407-415.

Singer, R. 1962. The Agaricales in Modern Taxonomy. 2nd Ed. Cramer, Weinheim. 915 p.

Smith, A. H. 1935. Unusual Agarics from Michigan III. Papers Mich. Acad. Sci. Arts, Let. Vol 21: 147.

_______________. 1941. Studies of N. Am. Agarics I. Contrib. Univ. Mich. Herb. no. 5: 1-73.

_______________. 1944. N. Amer. Agarics. Bull Torrey Bot. Club 71: 396-7.

Smith, A. H. and Hestler. 1943. New Agarics from Tennessee. Lloydia Vol 6(4): 255-260.

Speggazini, C. 1881. Fungi Argentini. Ann. Soc. Cient. Arg. 12: 13-30.

Wells, V. and P. Kempton. 1971. Studies on the fleshy fungi of Alaska - V. The genus *Strobilurus* with notes on extra-limital species. Mycologia 63 (2): 370-380.

MYCOTAXON

Vol. IX, No. 1, pp. 232-238 June 12, 1979

FILOBOLETUS PROPULLULANS, A NEW POROID AGARIC FROM PANAMÁ

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SUMMARY

Filoboletus propullulans, from Barro Colorado Island, Panamá, is a new species of Filoboletus Henn. This species is delimited from Filoboletus gracilis (Klotzsch apud Berk.) Sing. by its pleurocystidia, cheilocystidia, and distinctive diverticulate cutis with subcellular hypoderm.

INTRODUCTION

The tropical genus Filoboletus consists of small mycenoid fungi with tubulose hymenophore, central stipe, and smooth amyloid spores. Filoboletus sensu Höhnel (1908) may differ from Filoboletus as originally conceived by Hennings in 1900 (Donk, 1962). Since Hennings' type has been destroyed, Singer (1976) interprets Filoboletus as did Höhnel. The interpretation of the genus for this publication is that delimited by Höhnel and followed by Singer.

Six species of Filoboletus are to be found in the literature. Five of them, F. mycenoides, F. manipularis, F. gracilis, F. luteus, and F. staudtii are discussed by Singer (1945). A sixth species, F. hanedai (Kobayasi) Hongo, first described as a Poromycena (Kobayasi, 1951) has since been recombined in Filoboletus by Hongo (1955).

This paper describes a seventh species, F. propullulans, from Barro Colorado Island, Panamá.

Color terminology is that of the Methuen Handbook of Colour, 1967.

DESCRIPTION

Filoboletus propullulans LIBONATI-BARNES sp. nov. (Fig. 1-5)

Pileus convexus vel breviter conicus, aliquantum umbonatus, circularis, glabratus, 8-20 mm latus, ubi vivens pallido-cinereus, fuscatus in disco, ubi siccatus albidus vel cremeus, fuscatus in disco; caro disci 0.5 mm crassa, pallida, gelatinosa; margo pilei tenuis, aliquantum undulatus; tubi adnati, breves, 0.1 mm profundi; pori circulares vel parum angulares, 7-9 per mm, non radiatim dispositi, ubi vivens albidi, fuscati ubi siccatus; stipes centralis, cavus, longitudinaliter fibroso-striatus, leviter flocculosus, 15-25 mm longus, 2-3 mm crassus, ad apicem incrassatus (2.5-3.5 mm crassus) et ad basi incrassatus (2.5-3.7 mm crassus), ubi vivens albus, ubi siccatus cinereo-cinnamomeus, ad basim pilis parvulis aureo-brunneis.

Sporae 4.2-6 x 5.2-6.5 μm (-7.5 μm), subglobosae vel ovatae, inaequilaterales, laeves, hyalinae, amyloideae; basidia 20-23.4 x 5-8.3 μm, cylindrica, clavata, vel irregulariter tumida; sterigmata 4, ad 5.2 μm longa quorum duo plerumque longiora sunt; pleurocystidia 26-41 x 3.8-4.1 μm, filiformia, tenuitunicata, infrequencia; cheilocystidia 20-35 x 10-12.5 μm, saepe clavata, interdum lecythiformia vel obpyriformia, aliter versiformia, ad marginem tuborum abundantia; trama tuborum parallela, ex hyphis 3.8-10 μm latis, agglutinatis et gelatinosis constantes, tubi 110-140 μm profundi, pariebus 6.3-44 μm crassis hymenio excluso; subhymenium valde agglutinatum; contextus pilei ex hyphis confertis intertextis super tubos, laxe intertextis infra pagina pilei constans, hyphae aliquantum gelatinosae, inflatae, quarum aliqui angustate (3.1-6.3 μm latae) et aliae latae (10-27 μm latae) sunt, etiam cum hyphis paucis gloeopleris 3.8 μm latis; pagina pilei ex hyphis radiantibus, repentibus, diverticulatis, 6.3-18 μm latas constans, pagina strati hypharum 2-3,

hypoderma ex cellularis irregulariter angularibus, 19-88 x 63-75 µm; stipes ex stratis tribus compositus: stratum extimum ex hyphis 3.8-12.5 µm latis, longitudinalibus, parallelis constans, stratum medium ex hyphis inflatis, 8.8-19 µm latis constans, stratum intimum ex hyphis laxe intertextis (5-12.5 µm latis) constans; basis stipitis ex hyphis agglutinatis intertextis 8.8-23 µm latis constans; hyphae gloeoplerae, 5-6.25 µm latae, subinde in strato extimo stipitis adsunt; caulocystidia tenuitunicata, saepe collapsa, vesiculata vel brevi-clavata, ad apicem stipis 7.5-13.8 x 15-31.3 µm, versus basem stipis elongata (6.3-13.8 x 44-106 µm), trichodermium ad basem stipitis facientia; fibulae in pileo et stipite adsunt.

Holotypus SDLB 773, in ramosis delapsis arborum frondosarum, in Insula Barro Colorado, Panamá, 16 July 1976 lectus; in herbario Universitatis Washingtoni conservatus (WTU).

PILEUS convex of shallowly conical, slightly umbonate, roughly circular, glabrous, 8-22 mm in diameter, when fresh pallid greyish white, with a darker disk, when dry becoming ivory to cream with a pale yellow to dull greyish orange disk; flesh 0.5 mm thick on the disk, narrowing evenly toward the margin, concolorous with the pileal margin, appearing gelatinous; pileal margin thin, slightly undulate.

TUBES adnate, shallow, slightly more so toward the pileal margin, 0.1 mm deep; pores round to slightly angular, 7-9 per mm, not at all radially oriented, white when fresh, cream to pale greyish brown when dry.

STIPE central, hollow, longitudinally fibrous-striate, faintly flocculose, 15-25 mm long, 2-3 mm in diameter, flaring slightly both at the apex (2.3-3.5 mm) and at the base (2.5-3.7 mm), white when fresh, drying to greyish cinnamon brown, with sienna brown at the apex; base of the stipe clothed with golden brown scurfy-pruina and also extending into an investing web of hyphae on the substratum.

SPORES 4.2-6 x 5.2-6.5 (-7.5) µm, on the average 5.3 x 5.9 µm, subglobose, or ovoid, inaequilateral, smooth, with or without granules or oil drops, hyaline, amyloid.

BASIDIA 20-23.4 x 5-8.3 µm, cylindric, clavate, or irregularly swollen, 4-spored with sterigmata up to 5.2 µm long, of which two are usually distinctly longer than the other two; basidioles noticeably rectangular.

PLEUROCYSTIDIA 26-41 x 3.8-4.1 µm, filiform, thin-walled, rare; cheilocystidia 20-35 x 10-12.5 µm, abundant at the tube mouths, many clavate, a few lecythiform or obpyriform, the rest irregular in shape.

TUBE TRAMA parallel, of hyphae 3.8-10 µm in diameter, firmly agglutinated, with walls somewhat gelatinized; tubes 110-114 µm deep, walls 6.3-44 µm thick exclusive of hymenium; subhymenium of interwoven agglutinated hyphae.

PILEAL CONTEXT of hyphae densely interwoven just above the tubes, becoming loosely interwoven toward the pileal surface; hyphae somewhat gelatinized, inflated, some narrow (3.1-6.3 µm in diameter) others broad (10-27 µm in diameter); gloeoplerous hyphae occasional, 3-7 µm in diameter, densely-staining in phloxine.

PILEAL SURFACE of diverticulate hyphae forming a cutis, i.e., radially oriented repent hyphae 6.3-18 µm in diameter, 2-4 hyphae thick, underlain by a subcellular hypoderm 1-4 layers thick of cells irregularly angular by mutual compression and 19-88 x 63-75 µm in size.

STIPE of three layers: the outermost layer of longitudinal, straight, parallel, agglutinated hyphae, 3.8-12.5 µm in diameter, a middle layer of somewhat more inflated hyphae 8.8-18.8 µm in diameter, and an inner layer of hyphae, interwoven, 5-12.5 µm in diameter, lining the lumen of the stipe. Stipe base of interwoven agglutinated hyphae 8.8-23 µm in diameter, spreading out on the substratum into an investing web of hyphae 2.5-5 µm in diameter. Gloeoplerous hyphae (5-6.25 µm in diameter) occasional in the outermost layer of the stipe.

CAULOCYSTIDIA thinwalled, often collapsed, vesiculose, short-clavate, present the length of the stipe, shorter near the apex of the stipe (7.5-13.8 x 15-31.3 µm) elongating into cystidioid processes 6.3-13.8 x 44-106 µm which form a trichodermium at the very base of the stipe.

CLAMPS present in the pileal context, occasional in the tube trama, not seen at the bases of the basidia or

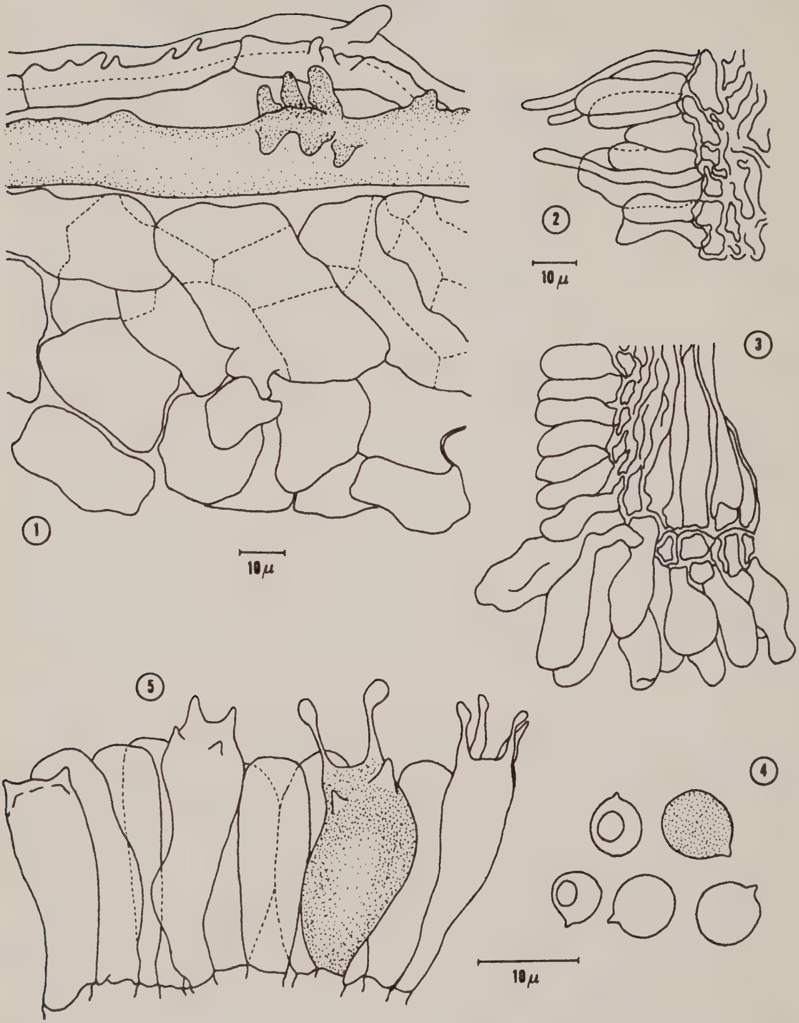

Fig. 1-5. Filoboletus propullulans, 1. pileal surface, showing diverticulate hyphae of the cutis, and the underlying subcellular layer (radial section), 2. filiform pleurocystidia, 3. edge of a tube, showing various shapes of cheilocystidia, and a segment of the hymenium, 4. spores, 5. basidia in several stages of development.

cystidia; occasional in the outer and middle layers of the stipe, abundant in the inner layer and in the investing web.

HABITAT on fallen logs of _Tachigalia versicolor_ (Leguminosae) which were known to be dead at least nine years (Foster, 1977), and on fallen branches of other frondose trees. Carpophores solitary or in twos, single or gregarious.

MACROCHEMICAL REACTIONS: flesh of the pileus and of the tubes slowly becoming chocolate brown in 2% phenol.

MATERIAL EXAMINED: Panamá, Barro Colorado Island, HOLOTYPE SDLB 773, 16 July 1976; PARATYPE SDLB 1101, 12 August 1976.

OBSERVATIONS: This species is closely related to _Filoboletus gracilis_ (Klotzsch ex Berk.) Sing. from which it can be distinguished by the diverticulate hyphae of the cutis, the presence of pleurocystidia, the clearly differentiated cheilocystidia, and the spores which are more globose than ellipsoidal. In addition, the tubes of _F. propullulans_ are uniformly short, and the pores quite small.

ACKNOWLEDGEMENTS

I wish to acknowledge R. Foster of the University of Chicago and D. Janos and E.G. Leigh of the Smithsonian Tropical Research Institute for their assistance on Barro Colorado Island. I also thank R. Fogel of the University of Michigan Herbarium and D. Farr of the Bureau of Plant Industry for the loan of specimens, and especially Dr. D.E. Stuntz for his critical comments. This paper resulted from a study supported by a Noble Fellowship from the Smithsonian Tropical Research Institute.

LITERATURE CITED

Donk, M.A. 1962. The generic names proposed for Agaricaceae. Nova Hedwigia 5:1-320.

Foster, R.B. 1977. Tachigalia versicolor is a suicidal neotropical tree. Nature 268:624-626.

Hennings, P. 1900. Fungi Monsunenses II. Monsunia 1: 137-147.

Höhnel, F. v. 1908. Fragmente zur Mykologie, Mitteilung 5. Sitzungsb. k. Akad. Wiss. 117(1): 985-1032.

Hongo, T. 1955. Journal of Japanese Botany (Shokubutsu Kenkyū Zasshi) 30: 75.

Kobayasi, Y. 1951. Contributions to the luminous fungi from Japan. Journal of the Hattori Botanical Laboratory (Hattori Syokobutu Kenkyūsyo) 5: 1-6.

Kornerup, A. and J.H. Wanscher. 1967. Methuen Handbook of Colour. 2nd Ed., Methuen Co., Ltd., London. 243 p.

Singer, R. 1945. The Laschia-complex (Basidiomycetes). Lloydia 8(3): 170-230.

Singer, R. 1975. The Agaricales in Modern Taxonomy. Ed. 3, J. Cramer, Weinheim, 912 p.

MYCOTAXON

Vol. IX, No. 1, pp. 239-242 June 12, 1979

CHRYSOCONIA, A GASTEROID MEMBER OF THE CONIOPHORACEAE

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Chrysoconia orthospora was first observed in the Spring of 1975 growing on decaying twigs and leaf matter brought into the laboratory for observation. The plant debris was collected from the bottom of a stagnant pool near the Montlake Playground on Lake Union, in Seattle. The debris was placed in petri dishes and kept submerged in distilled water by periodic replenishment of evaporated water for 4 weeks. After 4 weeks the material was allowed to dry out slowly. By 6 weeks one plate had produced a crop of golden brown tufts which, on close examination, proved to be cluster of basidia bearing orthotropically attached brown, smooth spores.

In the Spring of 1976 an attempt was made to obtain a second collection of C. orthospora. Plant debris was collected from the same location and treated as described above. Once again the fungus appeared on one plate (out of 10) after about 6 weeks of incubation in the laboratory. This time fresh specimens were transferred to culture media in an attempt to grow C. orthospora axenically. Pure cultures were obtained by succesive transfer of hyphal tips from cultures growing on Difco Corn Meal Agar. Near normal fruiting has been repeatedly obtained on cold soil extract agar. Cold soil extract medium is prepared by extracting 200 g of fresh garden soil with 600 ml of distilled water for 30 minutes at room temperature, then filtering through a Whatman #1 filter paper. The filtrate is brought to 500 ml and supplemented with 0.25 g of Difco Yeast Extract, 2 g of soluble starch, and 7.5 g of Bacto Agar before autoclaving at 15 lb/in^2 for 15 minutes.

Chrysoconia orthospora sporocarps appear to be little more than hyphal tufts 0.1-0.2 mm in diameter bearing basidia on all surfaces. The mature sporocarps are usually more or less hemispherical but can be somewhat dendritic (Fig. A). In either case, the fruiting body arises directly from the substratum with no apparent subiculum. The basidia of C. orthospora are clavate, usually bearing two spores attached orthotropically to the sterigmata (Fig. B).

The spores are brownish orange with smooth walls, an apical germ pore, and a thin-walled pedicel (Fig. D). The hyphae making up the sporocarp bear clamp connections (Fig. C) typical of those found in Basidiomycetes.

The color terms cited are from Ridgway's Color Standards and Nomenclature (1912) and determined under a dissecting microscope illuminated with a tungsten lamp.

The shape of the basidiocarp and, above all, the orthotropic attachment of the spores, suggest the creation of a new genus and we propose the name _Chrysoconia_ for this new member of the family Coniophoraceae.

Chrysoconia, gen. nov.

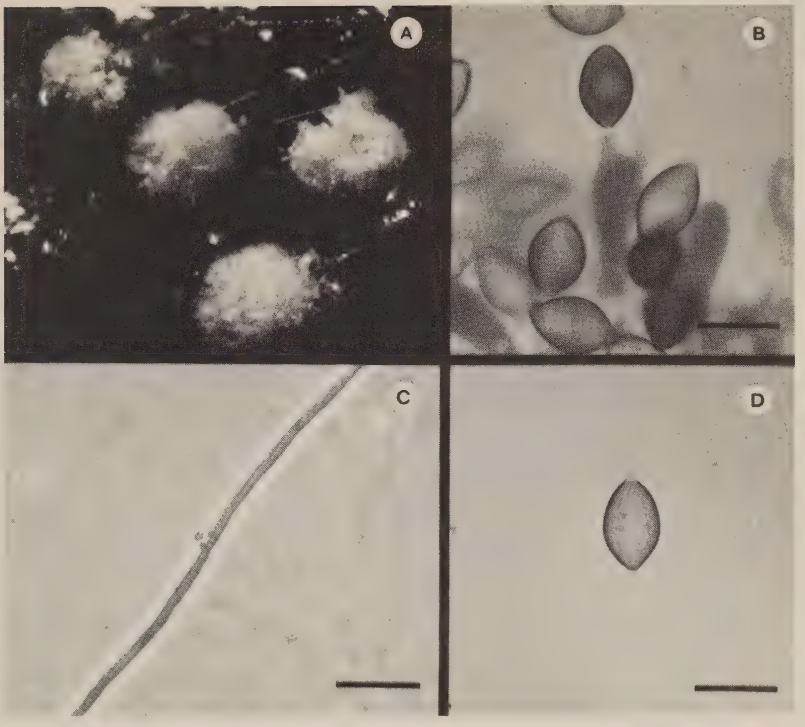
Basidiocarpo hemisphaerico vel dendritico, basidiis in omnibus superficiebus. Sporis brunneis, laevibus, orthotropice affixis, tunica strato cyanophilo.
Typus: _Chrysoconia_ _orthospora_.

Basidiocarp hemisphaerical to dendritic, with basidia on all surfaces. Spores brown, smooth, orthotropically attached, with a cyanophilous wall layer.
Type: _Chrysoconia_ _orthospora_.

Chrysoconia _orthospora_, sp. nov. Figs. A-D.

Basidiocarpo hemisphaerico vel dendritico, 0.1-0.2 mm diametro, basidiis in omnibus superficiebus. Hyphis hyalinis, fibulatis. Basidiis clavatis, bisporis, 24-28 x 7-10 µm; sporis ellipticis, laevibus, in cumulo brunneis ("Mars Yellow"), 11-14 x 7-8 µm, orthotropice affixis, tunica strato cyanophilo, pedicello laevitunicato et poro germinatione apicalibus.
In materia incubata vegetabili putrescenti in liti lacu Union lecta.
Holotypus DEM 242 in herbario Universitatis Washingtonii (WTU) conservatus.
Paratypus DEM 243 (WTU).

Basidiocarp hemisphaerical to dendritic, 0.1-0.2 mm in diameter, with basidia on all surfaces. Hyphae hyaline, with clamp connections. Basidia clavate, bearing 2 spores, 24-28 x 7-10 µm; spores elliptical, smooth, brownish ("Mars Yellow") in mass, 11-14 x 7-8 µm, orthotropically attached, with a cyanophilous wall layer, with a thin-walled pedicel and an apical germ pore.
On incubated decaying vegetable matter collected on the shore of Lake Union, Washington.
Holotype: DEM 242 deposited in the University of Washington Herbarium (WTU).
Paratype: DEM 243 (WTU).



Figures A-D. Chrysoconia orthospora. A. Mature sporocarps. X100. B. Basidium with orthotropically attached spore. Bar = 10 μm. C. Septum bearing clamp connection. Bar = 10 μm. D. Mature spore. Bar = 10 μm.

DISCUSSION

Chrysoconia orthospora is placed in the family Coniophoraceae because of its smooth brown spores, with a cyanophilous wall layer, born on an unpatterned hymenophore. Chrysoconia orthospora differs from all the other members of the Coniophoraceae in two major respects; the hemispherical to dendritic sporocarp composed of hyaline clamped hyphae and the orthotropic attachment of the basidiospores. The type of basidiocarp exhibited by the new fungus is without parallel in the Coniophoraceae, although clamp connections are known to occur in the genus Jaapia. This genus is easily recognized by its long non-septate cystidia and its spores commonly showing contraction of the cytoplasm (Nannfeldt and Eriksson, 1953). Although we accept the family Coniophoraceae in its modern sense (Donk, 1964; Talbot, 1973) we have considered it necessary to expand its limits to include this new gasteroid member. Oberwinkler (1977a, 1977b) has pointed out the occurrence of gasteroid basidia in several groups of Hymenomycetes. We report here for the first time the presence of such basidia in the family Coniophoraceae.

LITERATURE CITED

Donk, M.A. 1964. A conspectus of the families of the Aphyllophorales. Persoonia 3: 199-324.

Nannfeldt, J.A. and J. Eriksson. 1953. On the hymenomycetous genus Jaapia Bres. and its taxonomical position. Sv. Bot. Tidskr. 47: 177-189.

Oberwinkler, F. 1977a. Das neue System der Basidiomyceten, p. 59-105. in H. Clémençon (ed.). Species Concept in Hymenomycetes. Bibliotheca Mycologica 61. J. Cramer, Vaduz.

Oberwinkler, F. 1977b. The morphology of the basidium and its significance for the phylogeny of the Basidiomycetes. IMC 2 Abstracts: 483.

Ridgway, R. 1912. Color Standards and Nomenclature. Publ. by the author, Washington, D.C. 43 pp.

Talbot, P.H.B. 1973. Aphyllophorales I: General Characteristics; Thelephoroid and Cupuloid Families, p. 327-349. in G.C. Ainsworth, F.K. Sparrow and A.S. Sussman (ed.). The Fungi, Vol. IV B. Academic Press, New York.

MYCOTAXON

Vol. IX, No. 1, p. 243 June 12, 1979

THE CONTRIBUTORS AND DANIEL STUNTZ

by David L. Largent

Seventeen individuals contributed to this special FESTSCHRIFT issue dedicated to Daniel E. Stuntz. David Hosford's introductory article on Dan lists those who were or are his graduate students: David Hosford, Gustavo Escobar, Robert Gilbertson, Darryl Grund, David Largent, Joanne Williams Lennox, Susan Libonati-Barnes, Currie Marr, Jim Trappe and Fred VandeBogart. Dennis McCabe and David Gotelli were students of Howard Whisler and became associated with Dan through his infamous laboratory feasts which he always has available for the ravenous graduate students. Dennis Oliver was a student of David Hosford through whom he met Dan. Margaret Barr-Bigelow, Howard Bigelow, Harry Thiers and Alexander Smith have been close colleagues of Dan ever since the many unforgettable field trips at the Michigan Biological Station.

All the contributors were asked to write a short paragraph indicating how they met Dan. Included in these comments were several statements which summarized the feelings of each and every contributor for Dan. The comments which follow "speak" for all who have had the pleasure of Daniel Stuntz' company.

Dan Stuntz is one of the finest persons we know and one of the few people who we use as a model of the perfect academician.

Dan arrived while I was out collecting and amazed my wife by entertaining my daughter with stories from Winnie the Pooh. My daughter considered him a very special person from that day to the present.

He lets students work on their own, counting on their interest in the fungi to carry them through. His confidence in the power of a student's interest is one of the best things about him as a major professor. His teaching is superb; clear, witty (subtly so), and generous. He shares freely any of this extensive knowledge about the fungi. His ability to see the value of amateurs who like fungi is truly exceptional.

As a graduate student being introduced into the mysteries of "higher fungi", I appreciated his humor, his quiet, helpful suggestions when an agaric just would not key, and his firm attitude toward wayward fungi.

As others know well though, time plays no part in a friendship with Dan--after a period of years, when you meet again it is just like yesterday that you parted.

It should be obvious that he is a special person to me.

MYCOTAXON

Vol. IX, No. 1, pp. 244-276 June 12, 1979

LACCASE AND TYROSINASE OXIDATION OF SPOT TEST REAGENTS

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SUMMARY

In a 72 specimen sample, including sporocarp tissue of mostly Agarics, laccase and tyrosinase oxidation was evaluated for 6 spot test reagents commonly used in the taxonomy of Basidiomycetes. Oxidation effectiveness of reagents was determined by associating positive responses with enzyme occurrence. Laccase was detected by a syringaldazine spot test and tyrosinase by a L-tyrosine spot test. Results indicated that pyrogallol, guaiac and guaiacol spot test reagents are nonspecific for laccase and tyrosinase; although, guaiac and guaiacol are more effectively oxidized by laccase than tyrosinase. 1-Naphthol is laccase-specific, but some kinds of laccase activity are not detected by this reagent. Phenol and p-cresol reagents are tyrosinase-specific. For each reagent, laccase and tyrosinase oxidation curves are contrasted, and for most reagents the greatest differentiation between the two oxidases occurs within the first 15 min of the 30 min testing period. Factors discussed which influence substrate specificity are pH, isoenzymes, and potential peroxidase interference. For morphogenetic, ecological and taxonomic studies, spot tests are potentially valuable tools for studying enzyme localization among taxa and ontologically changing patterns within taxa.

INTRODUCTION

Since the discovery that tincture of guaiac turns blue when applied to some fungi and that this reaction usually denotes the presence of phenoloxidases, numerous other phenols have been used to determine the existence of the phenoloxidases, laccase and tyrosinase. Hundreds of mycelial cultures (Käärik 1965) and basidiocarps have been surveyed for these enzymes (Matsubara and Iwasaki 1972, Lamaison 1976), and results of phenoloxidative tests have been particularly useful in classifying "brown and white-rot" fungi (Davidson et al. 1938, Nobles 1971). Phenolic spot test reagents used in the taxonomy of agarics are generally prepared in the manner described by Singer (1975) and Watling (1971). Although the method of reagent preparation, particularly the factor of pH, is known to influence substrate specificity, oxidation of these reagents by phenoloxidases has not been critically evaluated. The purpose of this study is to compare the oxidation effectiveness of laccase and tyrosinase for 6 spot test reagents in common use: p-cresol, guaiac, guaiacol, 1-naphthol, phenol, and pyrogallol.

Oxidation effectiveness was determined by correlating the results of phenoloxidase identifier tests, which used syringaldazine and L-tyrosine as substrates, with the other 6 spot tests. Syringaldazine was introduced by Harkin et al. (1973, 1974) as an ideal substrate for laccase because it does not react with tyrosinase, nor does it autooxidize or produce peroxides. L-tyrosine is generally considered (Yasanobu 1959, Decker 1977) to be the most specific substrate of tyrosinase and is used in the standard assay for this enzyme. Tyrosine measures most, if not all active tyrosinase, but is neither oxidized by laccase nor peroxidase to melanins (Sarkanen 1971, Smith and Swan 1976). A basic assumption of this study is that the syringaldazine and tyrosine tests are specific identifiers for laccase or tyrosinase, and that these identifier tests can be used to detect and differentiate laccase and tyrosinase oxidation occurring in the other 6 spot tests, the correlator tests. Positive, negative, and no associations of correlator and identifier tests were determined by Chi Square.

METHODS

The preparation and characteristics of the reagents used, and the color of positive tests are given in Table I. The tyrosine spot test method utilized in this study is new. A major obstacle to using tyrosine as a spot test reagent has been its insolubility in alcohol and in water at room temperature. This problem was resolved in this study by heating the solution to 95°C and applying it at 90°C to the sample in a cold depression plate. The apparent effect of this procedure was to obtain maximum solubility of tyrosine and to destroy cellular membranes, thereby, releasing intracellular tyrosinase. The reagent cooled rapidly enough that appreciable enzyme deactivation did not occur, and a strong red-brown color developed when tyrosinase was present. In specimens devoid of laccase, peroxidase occurrence was identified by the method of Harkin et al. (1974), using syringaldazine and 0.03% hydrogen peroxide. There are many gaps in the biochemical details of the enzymatic reactions involved in spot tests, but some reaction products are known or hypothesized. Reaction products, located in the literature, are presented in Table II.

Tissue samples from the basidiocarps of all 72 specimens studied gave positive reactions with one or more of the phenolic spot tests. Specimens were collected during the summer of 1977, most of them were obtained from the 360 acre SUNY Biological Field Station at Cooperstown, N.Y. The sample was taxonomically heterogeneous represented by 60 species belonging to 38 genera and 18 families of Basidiomycetes (see results).

Small slices of tissue, about 5-10 mm dia and 2 mm thick, were removed from reactive areas of the basidiocarp, frequently from the apex of the stipe and context of the pileal disc. The slices were placed in the cavities of distilled-water rinsed, porcelain, depression plates. Two depression plates were used for a single test series, each containing 10 slices of tissue. Systematically, the eight reagents listed in Table I were added to the tissues, each tissue submerged in several drops of one reagent. Two pieces of tissue were used as controls, one being covered by distilled water and the other by 95% ethanol. A similar procedure was followed in the second depression plate, but with the addition to all 10 slices of several drops of freshly prepared, aqueous 0.03% H_2O_2 solution. Positive color reactions were recorded immediately following application of all reagents, 0 min, and subsequently at 5, 15, and 30 minutes later.

The significance of association between correlator and identifier tests was determined by Chi Square according to the formulas given by Zar (1974). The symbols

TABLE I. SPOT TEST REAGENTS: PREPARATION, CHARACTERISTICS, POSITIVE TESTS

Preparation of Reagent	REAGENT COLOR New Solution*	Old Solution**	pH OF REAGENT New Solution*	Old Solution**	Color of Positive Test
p-Cresol 1 ml of p-Cresol in distilled water, final volume 100 ml. Heat to dissolve solute.	Colorless	Colorless	pH 6.2	pH 6.6	red-brown, orange-brown, rust-red
Guaiac 2 g of Gum Guaiac powder in 95% ethanol, final vol. 100 ml. After several hrs filter solution.	Yellow-brown	Dark reddish-brown	pH 6.0	pH 5.5	deep blue
Guaiacol 2 ml of Guaiacol in distilled water, final vol. 100 ml. Shake, use aqueous phase.	Colorless	Pale red-brown	pH 5.9	pH 3.9	pink, red, red-brown
1-Naphthol 2.5 g of 1-Naphthol dissolved in 50 ml of 95% ethanol. Slowly add distilled water to 100 ml mark. Filter out precipitate.	Reddish cocoa-brown, cloudy	Same color but darker	pH 5.2	pH 4.5	violet to dark purple
Phenol 2 g of Phenol in distilled water, final vol. 100 ml.	Colorless	Colorless	pH 5.8	pH 6.6	red or violet changing to red-brown or violet-brown
Pyrogallol 10 g of Pyrogallol in distilled water, final vol. 100 ml.	Pale straw-yellow	Brownish-orange	pH 4.1	pH 3.2	orange-yellow, carrot-red to orange-brown
L-Tyrosine 0.5 g of L-Tyrosine in distilled water, final vol. 100 ml. Heat solution to 95°C to dissolve solute. Apply reagent at 90°C.	Colorless at 90°C, white precipitate at room temp.	Not determined	pH 6.2 at 90°C pH 7.0 at 28°C	Not determined	rust-red changing to red-brown and darker brown with time
Syringaldazine 0.1 g of Syringaldazine (Aldrich Co.) in 95% ethanol, final vol. 100 ml. Heat gently to dissolve solute. Cold temp. causes precipitation.	Pale greenish-yellow	Pale yellow	pH 7.1	pH 6.9	pink, red, violet-red, sometimes reaction decolorizes

*New Solution - color and pH determined 24 hrs after preparation.
**Old Solution - color and pH determined from a 7 month-old solution stored at 28 C.

TABLE II. SUBSTRATES AND REACTION PRODUCTS

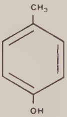
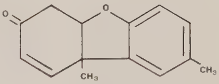
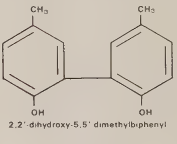
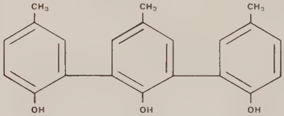
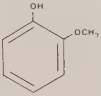
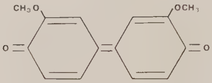
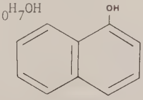
SUBSTRATES Common Name Scientific Name Type of Phenol Formulas and Molecular Weight	REACTION PRODUCTS * products of laccase oxidation ** products of peroxidation (Sarkanen 1971, Higuchi 1958 regard products similar or identical to laccase oxidation) *** products of tyrosinase oxidation
p-Cresol 4-hydroxy Toluene Monohydric phenol, -OH group 4 position $CH_3C_6H_4OH$  p-Cresol Mol. Wt. 108.14	 Pummerer's Ketone tetrahydrodibenzofurane  2,2'-dihydroxy-5,5' dimethylbiphenyl  terphenyl derivative (*) (**) Laccase and peroxidase oxidize p-cresol to the above products, forming a white precipitate (Westerfeld and Lowe 1942, Fåhraeus and Ljunggren 1961, Benfield et al. 1964) (***) Tyrosinase oxidizes p-cresol to a dark-colored quinonoid compound (Fåhraeus and Ljunggren 1961, Küster and Little 1963)
Guaiacol 2-methoxy-phenol Monohydric phenol, -OH group 1 position $2\text{-}CH_3OC_6H_4\text{-}1\text{-}OH$  Guaiacol Mol. Wt. 124.14	 3,3'-dimethoxydipheno-4,4'-quinone (**) The above compound is a red-brown pigment, the principal product of peroxidation of guaiacol. A minor constituent of peroxidation is 3,3'-dimethoxydipheno-2,2'- quinone (Saunders 1973) (**) Formerly, the peroxidation product of guaiacol was regarded as tetraguaiacol or tetraguaiacoquinone (Maehly and Chance 1954, Demirevska-Kepova and Bakardjieva 1976)
1-Naphthol 1-hydroxy naphthalene Monohydric phenol, - OH group 1 position $C_{10}H_7OH$  1 Naphthol Mol. Wt. 144.17	Specific reaction products have not been located in the literature.

TABLE II. Continued

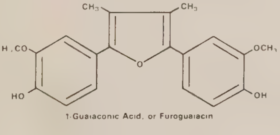
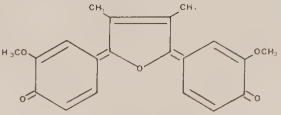
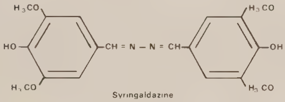
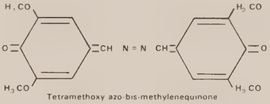
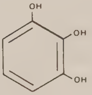
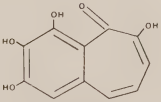
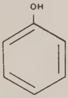
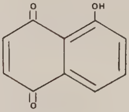
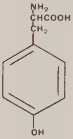
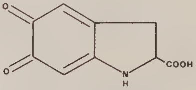
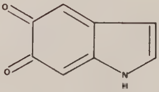
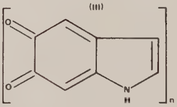
Guaiac (Guaiaconic Acid) 2,5-di-(4-hydroxy-3-methoxy-phenyl)-3,4-dimethylfuran (active compound of gum guaiac) -also known as furoguaiacin Dihydric phenol, -OH groups 4 position  1-Guaiaconic Acid, or Furoguaiacin Mol. Wt. 340.36	 Guaiacum Blue bis methylenequinone (*) (**) (***) All three enzymes oxidize furoguaiacin to guaiacum blue (Kratochvil et al. 1971)
Syringaldazine N,N'-bis-3,5-dimethoxy-4-hydroxybenzylidene hydrazine Dihydric phenol, -OH groups 4 position  Syringaldazine Mol. Wt. 360.36	 Tetramethoxy azo-bis-methylenequinone (*) (**) Laccase and peroxidase oxidize syringaldazine to a magenta-red pigment (Harkin and Obst 1973).
Pyrogallol 1,2,3-trihydroxybenzene Trihydric phenol, -OH groups in positions, 1,2,3 C_6H_3-1,2,3-$(OH)_3$  Pyrogallol Mol. Wt. 126.11	 Purpurogallin (*) (**) Peroxidase and laccase oxidation of pyrogallol results in a complex mixture of products, the principal product being an orange pigment, purpurogallin (Maehly and Chance 1954, Benfield et al. 1964). (***) Tyrosinase oxidation of pyrogallol presumably yields purpurogallin, but the reaction products may not have been analyzed.

TABLE II. Continued

Phenol Phenol Monohydric phenol, -OH group 1 position C_6H_5OH  Phenol	 Phenoquinone Specific reaction products of enzymatic oxidation of phenol have not been located in the literature. Noller (1957) notes that a complex mixture of products are formed in aerobic oxidation of phenol, the best known product being the bright red compound, phenoquinone.
L-Tyrosine L-Tyrosine Monohydric phenol, -OH group 4 position $4\text{-}HOC_6H_4CH_2(NH_2)COOH$  Tyrosine Mol. Wt. 181.19	(*) Laccase can not oxidize L-Tyrosine (Sarkanen 1971) (**) Peroxidase oxidizes L-Tyrosine to dityrosine [5,5'-bis(2-amino-2-carboxyethyl)-2,2'dihydroxybiphenyl] (Smith and Swan 1976) (I)  Dopachrome, or Hallachrome (II)  Indole 5,6-quinone (III)  Tyrosine-melanin (***) Tyrosinase oxidizes L-Tyrosine to dopa (3,4-dihydroxyphenylalanine). This is not accomplished by laccase or peroxidase, but all three enzymes can oxidize dopa to dopa quinone (Sarkanen 1971, Smith and Swan 1976). The tyrosine-tyrosinase melanin biopathway involves intermediate pigments such as the red dopachrome (I), purple or yellow Indole 5,6 quinone (II), as well as the brown-colored melanin (III) (Lerner and Fitzpatrick 1950, Hidaka 1976).

f_1 and f_2 represent the frequencies of positive and negative tests, and n the total sample size. When sample size was 20 or less, Chi Square was corrected for continuity, X_c^2 (Guilford 1965). Statistically significant associations, $X^2 \geq 3.841$ ($P \leq 0.05$), are indicated in Tables III to VII by + or - signs, depending on the direction of association.

$$X^2 = \frac{(f_1 - f_2)^2}{n} \qquad X_c^2 = \frac{(|f_1 - f_2| - 1)^2}{n}$$

RESULTS

This study is predicated on the assumption that the parameters measured by the identifier tests are the same as those measured by the correlator tests. If this is true, positive correlator tests should accompany reactions in one or both of the identifier tests. This relationship does exist (Table III). The mean value of association varies from 74% at 0 min to 90% at 30 min, and statistically, the association is strongly positive at 5, 15, and 30 min readings. While this positive correlation does not prove that oxidation by laccase or tyrosinase causes the positive correlator tests, it adds to the support of this hypothesis.

The 72 specimen sample is divided into 4 groups on the basis of identifier test results.

A. Group I consists exclusively of specimens containing both laccase and tyrosinase as indicated by positive syringaldazine and tyrosine tests. Typically, members of this group react rapidly, and all correlator tests are significantly positive at the 5, 15, and 30 min readings (Table IV). Specimens assigned to Group I are listed below by name, collection number and family.

NAME	NUMBER	FAMILY
Agaricus campestris L. ex Fr.	2784	Agaricaceae
Grifola frondosa (Dickson ex Fr.) S. F. Gray	2876	Polyporaceae

Lactarius chrysorheus Fr.	2798	Russulaceae
L. deceptivus Pk.	2875	"
L. gerardii Pk.	2749	"
L. vellereus (Fr.) Fr.	2781	"
L. sp.	2800	"
Russula alutacea (Pers. ex Fr.) Fr.	2747	"
R. emetica (Schaeff. ex Fr.) S. F. Gray	2868	"
R. fragilis (Pers. ex Fr.) Fr.	2853	"
R. nigricans (Bull.) Fr.	2828	"
R. pectinatoides Pk.	2748	"
R. rugulosa Pk.	2746	"
R. variata Banning	2697	"
R. variata Banning	2745	"

B. Group II consists exclusively of "laccase-only" specimens as determined by positive syringaldazine and negative tyrosine tests. Significant correlator tests of this group are positive guaiac and guaiacol and negative p-cresol and phenol tests (Table V). Specimens included in Group II are:

NAME	NUMBER	FAMILY
Agaricus campestris L. ex Fr.	2791	Agaricaceae
Cantharellus lateritius (Berk.) Sing.	2823	Cantharellaceae
Entoloma sp.	2866	Entolomataceae
Ramaria flavobrunnescens var. *aromatica* Marr	2855	Gomphaceae
Hericium ramosum (Bull. ex Mérat) Letellier	2741	Hydnaceae
Hygrophorus pratensis (Fr.) Fr.	2854	Hygrophoraceae
Hypomyces lactifluorum (Schw. ex Fr.) Tul. (plus unidentified host)	712	Hypocreaceae
Coriolus biformis (Fr. apud Klotzsch) Pat.	2836	Polyporaceae
C. versicolor (L. ex Fr.) Quél.	2730	"
C. versicolor	2782	"
C. versicolor	2787	"

Hirschioporus pargamenus (Fr.) Bond. & Sing.	2860	Polyporaceae
Hypsizygus marmoreus (Pk.) Bigelow	2879	Tricholomataceae
Panellus serotinus (Fr.) Kühner	2878	"
P. stipticus (Bull. ex Fr.) Karst.	2856	"
Pleurotus ostreatus (Jacq. ex Fr.) Kummer	2738	"
P. ostreatus	2701	"
Tricholoma resplendens (Fr.) Karst.	2825	"
T. sejunctum (Sow. ex Fr.) Quél.	2846	"

C. Group III consists exclusively of "tyrosinase-only" specimens as determined by negative syringaldazine and positive tyrosine tests. Significant correlator tests associated with Group III are positive p-cresol and phenol tests, and a negative 1-naphthol test; while, associations of slight statistical significance occur with guaiacol at 5 min and pyrogallol at 30 min (Table VI). Specimens included in Group III are:

NAME	NUMBER	FAMILY
Agaricus campestris L. ex Fr.	2784	Agaricaceae
Amanita rubescens (Pers. ex Fr.) S. F. Gray	2799	Amanitaceae
A. vaginata (Fr.) Vitt.	2667	"
A. sp.	2883	"
Cantharellus tubaeformis Fr.	2874	Cantharellaceae
Clavulinopsis fusiformis (Sow. ex Fr.) Corner	2726	Clavariaceae
Clavulina cristata (Fr.) Schroet.	2844	Clavulinaceae
Merulius tremellosus Schrad. ex Fr.	2831	Corticiaceae
Hygrophorus borealis Pk.	2880	Hygrophoraceae
Calvatia sp.	350	Lycoperdaceae
Gloeoporus dichrous (Fr.) Bres.	2728	Polyporaceae
Ischnoderma resinosum (Fr.) Karst.	2881	"

Laetiporus sulphureus (Bull. ex Fr.) Bond. & Sing.	2777	Polyporaceae
Tyromyces caesius (Schrad. ex Fr.) Murr.	2848	"
T. fragilis (Fr.) Donk	2872	"
Hypholoma capnoides (Fr.) Kummer	2826	Strophariaceae
Pholiota lenta (Fr.) Sing.	2849	"
P. squarrosoides (Pk.) Sacc.	2842	"
Stropharia ambigua (Pk.) Zeller	2832	"
Clitocybe clavipes (Fr.) Kummer	2824	Tricholomataceae
C. sp. (in Section Umbilicatae)	2885	"
Collybia dryophila (Bull. ex Fr.) Kummer	2750	"
C. subnuda (Ellis ex Pk.) Gilliam	2779	"
Laccaria ochropurpurea (Berk.) Pk.	2795	"
Marasmius oreades (Bolt. ex Fr.) Fr.	2739	"
Mycena serotina (Pk.) Smith	2847	"
Oudemansiella radicata (Relhan ex Fr.) Sing.	2725	"

D. Group IV consists exclusively of specimens giving negative identifier tests, but nevertheless, exhibiting one or more positive correlator tests. Throughout the 30 min test period "no association" characterizes the reactions occurring. Specimens included in Group IV are:

NAME	NUMBER	FAMILY
Agaricus campestris L. ex Fr.	2744	Agaricaceae
Cantharellus lateritius (Berk.) Sing.	2734	Cantharellaceae
Coprinus micaceus (Bull. ex Fr.) Fr.	2865	Coprinaceae
Ramaria botrytis (Fr.) Ricken	2873	Gomphaceae
Hericium ramosum (Bull. ex Mérat) Letellier	402	Hydnaceae
H. ramosum	2801	"
Perenniporia subacida (Pk.) Donk	2736	Polyporaceae

Pseudohydnum gelatinosum (Scop. ex Fr.) Karst.	2857	Tremellaceae
Flammulina velutipes (Fr.) Karst.	2859	Tricholomataceae
Oudemansiella radicata (Relhan ex Fr.) Sing.	2803	"
Panellus stipticus (Bull. ex Fr.) Karst.	2733	"

Species of Group IV may be of particular value in exploring the potential for peroxidase interference in phenoloxidase tests. Some of the reactions occurring in this group may represent low phenoloxidase activity not detected by the identifiers; however, there is the possibility that some of the reactions represent peroxidase activity. Of the 11 specimens included in Group IV, 7 specimens gave positive syringaldazine reactions upon the addition of 0.03% hydrogen peroxide (Table VIII). These results are generally interpreted as peroxidase activity (Harkin et al. 1974), but they may merely represent laccase activity enhanced by peroxide (Blaich and Esser 1975). Because of the small number of questionable reactions represented by Group IV, 15% of the 72 specimen sample, whether or not these possibly spurious reactions are taken into account does not qualitatively alter the conclusions of this study. Nevertheless, laccase and tyrosinase oxidation levels indicated in Figures I to VI may be slightly overstated, especially for guaiac and 1-naphthol.

Frequency levels of tyrosinase and laccase oxidation are contrasted graphically in Figures I to VI for each of the correlator spot test reagents. The capacity of a spot test reagent to selectively identify one of the phenoloxidases is directly related to the separation of the two oxidation curves, the area indicated by vertical lines. In this study the pyrogallol reagent possessed the least and the p-cresol reagent the most differential capacity. In general, the greatest differentiation between laccase and tyrosinase occurs within the first 15 min of the testing period. While it is tempting to observe tested material for 30 min or longer in order to detect slow reactions, the present data indicate that this may not be justified. Furthermore, it is possible that peroxidase interference steadily increases with time (Table VIII).

As fully substantiated by literature reports (Table IX), pyrogallol and guaiac are nonspecific reagents. Of these two, pyrogallol is the least differentiating, both oxidation curves being very close throughout the 30 min test period. The guaiac reagent is more effectively oxidized by laccase than by tyrosinase, and an immediate positive test probably signifies laccase activity. However, differentiation between the two enzymes is poor during the last 15 min of the test period. A serious drawback in using either of these reagents to detect total phenoloxidase activity is that 33% of the total tyrosinase activity goes undetected by guaiac, and 37% of the laccase and 22% of the tyrosinase activity goes undetected by pyrogallol.

Guaiacol and 1-naphthol substrates are commonly regarded as laccase specific (Table IX), but this categorization of guaiacol is questionable. While an immediate guaiacol reaction probably indicates laccase activity, tyrosinase appears to oxidize this substrate sufficiently to reduce drastically the value of this reagent, as formulated, to detect laccase. Guaiacol has been used by many investigators as a diagnostic substrate for laccase (Boidin 1951, Lyr 1958, Käärik 1965, Capellano and Demoulin 1969, Holubová-Jechová 1971, Ander and Eriksson 1976). Nevertheless, Higuchi (1958) showed that potato tyrosinase slightly oxidizes guaiacol, and Rösch (cf. Käärik 1965) indicated that guaiacol is oxidized by laccase at low pH values and by tyrosinase as well at higher pH values (pH 6.8-7.2). A freshly prepared guaiacol reagent, pH 5.9, is intermediate in value. The 1-naphthol test is significantly negative with "tyrosinase-only" species, a finding substantiated by other investigations (Yasanobu 1959). Higuchi and Kitamura (1953) were among the first to recognize the potential for using 1-naphthol to distinguish laccase from tyrosinase, and others have subsequently used this substrate diagnostically (Lyr 1958, Käärik 1965, Ander and Eriksson 1976). However, 1-naphthol is not an ideal detector of total laccase because of the frequency with which laccase activity goes undetected (Fig. IV). The peculiar shape of the laccase oxidation curve for 1-naphthol may indicate a combination of two reactions which are chronologically out of phase, the first reaction achieving peak activity during the lag phase of the second oxidation, or peroxidation, reaction. Because of the strong association ($P < 0.01$) of a negative 1-naphthol test in the "tyrosinase-only" group, a positive 1-naphthol test can generally be interpreted as indicating active laccase.

Both p-cresol and phenol are tyrosinase-specific substrates. Particularly p-cresol is an excellent substrate, detecting a maximum of tyrosinase activity and a minimum of laccase activity. This study supports the extensive diagnostic use made of p-cresol (Boidin 1951, Lyr 1958, Käärik 1965, Capellano and Demoulin 1969, Holubová-Jechová 1971, Ander and Eriksson 1976). Phenol has not been so widely used as a tyrosinase substrate, and while it is not recommended over p-cresol and tyrosine, a phenol reaction occurring within 15 min and possibly up to 30 min can be interpreted as evidence of tyrosinase activity.

Using Warburg manometry, Matsubara and Iwasaki (1972) obtained quantitative measures of laccase and tyrosinase activity for selected agarics. Their results are consistent with the qualitative determination of these enzymes by the identifier spot tests, syringaldazine and tyrosine. They found species of *Agaricus*, *Lactarius* and *Russula* to possess strong laccase and tyrosinase activity. Tyrosinase predominated in species of *Amanita*, *Collybia*, *Hygrophorus*, *Laccaria*, *Marasmius* and *Pholiota*, while, species of *Coprinus* exhibited very slight laccase activity. It is now clear that some of the larger families, such as the Tricholomataceae and Polyporaceae, include several phenoloxidase combinations such as those represented by Groups I, II, III, and IV. Extensive surveys of laccase and tyrosinase in these families are likely to prove valuable in resolving problems of taxonomy and evolution.

DISCUSSION

A large number of aromatic amines, phenols, and other compounds are known to be oxidized by laccase and tyrosinase (Hoffmann and Esser 1977, Yasanobu 1959). Differences in substrate specificity of these two enzymes have been vigorously sought, and until recently it was thought that tyrosinase, but not laccase, oxidized monophenols (Küster and Little 1963, Christman and Oglesby

1971). This generalization is certainly with exceptions. 1-Naphthol is a monophenol oxidized by laccase and not appreciably by tyrosinase, and the literature is replete with references to laccase oxidation of p-cresol to white compounds (Benfield et al. 1964, Blaich and Esser 1975, Dubernet et al. 1977). There appears to be no simple explanation to account for the observed substrate specificity of these enzymes. Yasanobu (1959) points out that a combination of different forces may be operating between enzyme and substrate, and other investigators have noted that laccase and tyrosinase exist in multiple forms, each form (isoenzyme) exhibiting a characteristic substrate-specific pattern. Blaich and Esser (1975) have studied two isoenzyme-complexes of laccase, and other researchers have described several molecular forms (Schánĕl and Esser 1971, Hoffmann and Esser 1977). Similarly, tyrosinase exists in multiple forms (Nelson and Mason 1970). The inability of some reagents to detect 100% frequency of enzyme occurrence (e.g. laccase detection by 1-naphthol), may be due to some isoenzymes, but not others, oxidizing the substrate.

Although the influence of pH on substrate specificity has been recognized in the past (e.g. Boidin 1951), only recently has the full importance of this factor been revealed. Tyrosinase activity has an approximate pH range of 3.5 to 7.1 (Käärik 1965), and a pH optimum of 6 to 7 (Nelson and Mason 1970, Gutteridge and Robb 1975, Decker 1977). The pH range for laccase activity is broader, 2-3 to 7-9.5 (Käärik 1965, Hoffmann and Esser 1977, Dubernet et al. 1977), but the pH optimum depends on the isoenzyme and substrate involved. For example, pyrogallol is oxidized by both laccase I and II at pH 5.0, but by only laccase I at pH 7.5; whereas gentisic acid is oxidized by both laccase I and II at pH 7.5 but only by laccase II at pH 5 (Schánĕl and Esser 1971). Thus, it is probable that a major source of variation in spot test results may be due to the lack of pH standardization. Furthermore, the specificity of reagents may be improved by pH control. Rösch (cf. Käärik 1965) suggested that guaiacol was laccase specific at low, but not at high pH values.

The extent to which positive spot tests are due to peroxidase mediated reactions is unclear. Laccase and peroxidase oxidize similar phenolic substrates, but presumably differ in their cosubstrate specificity, oxygen and peroxide respectively (Higuchi 1958, Sarkanen 1971). It is generally assumed that unless hydrogen peroxide is added to a specimen being tested that a positive reaction denotes the presence of phenoloxidases. This assumption was challenged when tincture of guaiac was found to produce peroxides (Maehly and Chance 1954, Harkin & Obst 1973), and that appreciable amounts of hydrogen peroxide were produced by wood-rotting fungi (Koenigs 1972). Also, Young (1973) discovered that minute quantities of hydrogen peroxide produced quinone reaction products in excess to what was predicted from the amount of peroxide present. In order to minimize peroxide contamination in this study reagents were freshly prepared approximately every two weeks, put in brown dropper bottles, and stored in the refrigerator. Peroxidase interference appears to be completely absent from the tyrosine test for tyrosinase. None of the 44 specimens giving a negative tyrosine test in air turned positive following application of 0.03% hydrogen peroxide, and Smith and Swan (1976) have indicated that peroxidase does not oxidize tyrosine to dopa except in the presence of dihydroxyfumaric acid and oxygen. Peroxidase interference of the syringaldazine-laccase test is less certain because this substrate is oxidized by both enzymes. According to Harkin et al. (1974) the levels of hydrogen peroxide produced by fungal hyphae, even in the high peroxide-producers identified by Koenigs, do not appreciably interfere with the syringaldazine-laccase test. Some of the reactions of the correlator spot tests may be peroxidase mediated and additional study of this problem is needed. The distinction between phenoloxidases and peroxidase is complicated even further by the discovery of "pseudoperoxidases". The activity of some laccase and tyrosinase isoenzymes is dependent on or enhanced by the presence of hydrogen peroxide (Stafford 1974, Blaich and Esser 1975, Gutteridge and Robb 1975, Decker 1977).

Spot tests have been a valuable investigative tool and with further research toward refinement their value should increase. The simplicity and rapidity of the tests make it feasible to conduct extensive surveys upon which taxonomic conclusions can be based. While this use of spot tests has occurred since the turn of the century, a great deal of reevaluation will be necessary with improved tests. Ecological studies of microbial decomposition of wood and humus have been accomplished with phenolic substrates (Schubert 1965, Hintikka 1970), and a new use for these tests is their application in morphogenetic studies. Localization of laccase and tyrosinase varies among species and during ontogeny within some species (Harkin et al. 1974, Turner 1974). These variations are undoubtedly of morphogenetic importance associated with several processes, e.g. pigmentation (Wickerham and Kurtzman 1975), fruiting (Turner 1974), and other processes. For the taxonomist and morphologist the ideal spot test repertoire would include general tests (e.g. measuring total active phenoloxidases), enzyme specific tests (e.g. measuring total active laccase), and isoenzyme specific tests. It would be essential for a good test to detect nearly 100% frequency of the enzyme and for spurious reactions not to occur. Presently, syringaldazine may be the best test reagent for detecting total active laccase, and L-tyrosine or p-cresol the better reagents for detecting total active tyrosinase; while, other enzyme specific reagents of limited value are 1-naphthol and phenol. Further study of substrate specificity, including the search for new specific substrates and the means for controlling specificity through pH, timing of tests, etc., should greatly increase the usefulness of spot tests.

ACKNOWLEDGEMENTS

To the following people I am most grateful for their generous commitment of time and professional skills toward the fulfillment of this research: Drs. Orson K. Miller, Jr., and Roy Watling for review of the manuscript, Dr. Madho Singh for advice on statistical methods, Ms. Belle Ang for writing a program to compute Chi Square, personnel of the Graphic Arts Department (SUCO) for producing the graphs and chemical formulas, and Mrs. Hilda S. Mercun for typing the final copy. The SUCO Biology Department provided facilities at the Field Station in Cooperstown, N.Y. where this study was conducted.

Special thanks is due to Dr. Daniel E. Stuntz who introduced his students to the application of spot tests in agarics, and who has since continued to provide intellectual and moral support for investigating the potential of these tests.

TABLE III. ASSOCIATION OF CORRELATOR REACTIONS WITH LACCASE, TYROSINASE IDENTIFIERS FOR THE TOTAL SAMPLE AT 0, 5, 15 AND 30 MIN

Time Reaction Recorded	Interpretation of Numbers	CORRELATOR TESTS						Mean of Tests
		Py	G	Gl	N	p-C	P	
0 min	Sample Size	13	24	19	10	7	7	13.33
	Reactions Assoc. with Identifiers	9	17	13	7	7	6	9.83
	Reactions Not Assoc. with Identifiers	4	7	6	3	0	1	3.50
	% of Association	69%	71%	68%	70%	100%	86%	74%
	X_c^2	1.23	4.17	1.89	0.90	5.14	2.29	2.13
	Correlation	0	+*	0	0	+*	0	0
5 min	Sample Size	38	42	30	25	33	37	34.17
	Reactions Assoc. with Identifiers	29	34	25	21	28	32	28.17
	Reactions Not Assoc. with Identifiers	9	8	5	4	5	5	6.00
	% of Association	76%	81%	83%	84%	85%	86%	82%
	X^2	10.53	16.09	13.33	11.56	16.03	19.70	14.38
	Correlation	+**	+**	+**	+**	+**	+**	+**
15 min	Sample Size	44	48	38	27	43	42	40.33
	Reactions Assoc. with Identifiers	36	39	33	22	35	38	33.83
	Reactions Not Assoc. with Identifiers	8	9	5	5	8	4	6.50
	% of Association	82%	81%	87%	81%	81%	90%	84%
	X^2	17.82	18.75	20.63	10.70	16.95	27.52	18.52
	Correlation	+**	+**	+**	+**	+**	+**	+**
30 min	Sample Size	50	58	45	34	48	48	47.17
	Reactions Assoc. with Identifiers	47	50	42	30	42	45	42.62
	Reactions Not Assoc. with Identifiers	3	8	3	4	6	3	4.50
	% of Association	94%	86%	93%	88%	88%	94%	90%
	X^2	38.72	30.41	33.80	19.88	27.00	36.75	30.81
	Correlation	+**	+**	+**	+**	+**	+**	+**

Abbreviations: syringaldazine (Sy), L-tyrosine (Ty), pyrogallol (Py), guaiac (G), guaiacol (Gl), 1-naphthol (N), p-cresol (p-C), phenol (P).
* = $0.05>P>0.01$, ** = $P \leq 0.01$

TABLE IV. CORRELATION OF SPOT TEST RESPONSES WITH FUNGI POSSESSING LACCASE AND TYROSINASE, GROUP I

Time Reaction Recorded	Sample Size	Interpretation of Numbers	ENZYME IDENTIFIERS		SPOT TEST CORRELATORS					
			Laccase	Tyrosinase						
			Sy	Ty	Py	G	G1	N	p-C	P
0 min	5	Reactions	5	5	4	5	5	3	3	3
		% of Sample	100%	100%	80%	100%	100%	60%	60%	60%
		X^2_c			0.80	3.20	3.20	0.00	0.00	0.00
		Correlation			0	0	0	0	0	0
5 min	12	Reactions	12	12	11	12	12	11	11	12
		% of Sample	100%	100%	92%	100%	100%	92%	92%	100%
		X^2_c			6.75	10.08	10.08	6.75	6.75	10.08
		Correlation			+**	+**	+**	+**	+**	+**
15 min	12	Reactions	12	12	11	12	12	11	12	12
		% of Sample	100%	100%	92%	100%	100%	92%	100%	100%
		X^2_c			6.75	10.08	10.08	6.75	10.08	10.08
		Correlation			+**	+**	+**	+**	+**	+**
30 min	15	Reactions	15	15	14	14	15	13	15	15
		% of Sample	100%	100%	93%	93%	100%	87%	100%	100%
		X^2_c			9.60	9.60	13.07	6.67	13.07	13.07
		Correlation			+**	+**	+**	+**	+**	+**

* = $0.05>P>0.01$

** = $P \leq 0.01$

TABLE V. CORRELATION OF SPOT TEST RESPONSES WITH FUNGI POSSESSING ONLY LACCASE, GROUP II

Time Reaction Recorded	Sample Size	Interpretation of Numbers	ENZYME IDENTIFIERS		SPOT TEST CORRELATORS					
			Laccase	Tyrosinase						
			Sy	Ty	Py	G	Gl	N	p-C	P
0 min	12	Reactions	12	0	3	11	8	4	0	0
		% of Sample	100%	0%	25%	92%	67%	33%	0%	0%
		X_c^2			2.08	6.75	0.75	0.75	10.08	10.08
		Correlation			0	+**	0	0	-**	-**
5 min	13	Reactions	13	0	7	13	9	8	0	2
		% of Sample	100%	0%	54%	100%	69%	62%	0%	15%
		X_c^2			0.00	11.08	1.23	0.31	11.08	4.92
		Correlation			0	+**	0	0	-**	-*
15 min	15	Reactions	15	0	9	15	13	8	0	3
		% of Sample	100%	0%	60%	100%	87%	53%	0%	20%
		X_c^2			0.27	13.07	6.67	0.00	13.07	4.27
		Correlation			0	+**	+**	0	-**	-*
30 min	19	Reactions	19	0	12	18	16	12	2	5
		% of Sample	100%	0%	63%	95%	84%	63%	11%	26%
		X_c^2			0.84	13.47	7.58	0.84	10.32	3.37
		Correlation			0	+**	+**	0	-**	0

* = $0.05>P>0.01$

** = $P \leq 0.01$

TABLE VI. CORRELATION OF SPOT TEST RESPONSES WITH FUNGI POSSESSING ONLY TYROSINASE, GROUP III

Time Reaction Recorded	Sample Size	Interpretation of Numbers	ENZYME IDENTIFIERS		SPOT TEST CORRELATORS					
			Laccase	Tyrosinase						
			Sy	Ty	Py	G	Gl	N	p-C	P
0 min	5	Reactions	0	5	2	1	0	0	4	3
		% of Sample	0%	100%	40%	20%	0%	0%	80%	60%
		X_c^2			0.00	0.80	3.20	3.20	0.80	0.00
		Correlation			0	0	0	0	0	0
5 min	20	Reactions	0	20	11	9	4	2	17	18
		% of Sample	0%	100%	55%	45%	20%	10%	85%	90%
		X_c^2			0.05	0.05	6.05	11.25	8.45	11.25
		Correlation			0	0	-*	-**	+**	+**
15 min	24	Reactions	0	24	16	12	8	3	23	23
		% of Sample	0%	100%	67%	50%	33%	13%	96%	96%
		X^2			2.67	0.00	2.67	13.50	20.17	20.17
		Correlation			0	0	0	-**	+**	+**
30 min	27	Reactions	0	27	21	18	11	5	25	25
		% of Sample	0%	100%	78%	67%	41%	19%	93%	93%
		X^2			8.33	3.00	0.93	10.70	19.59	19.59
		Correlation			+**	0	0	-**	+**	+**

* = $0.05 > P > 0.01$

** = $P \leq 0.01$

TABLE VII. CORRELATION OF SPOT TEST RESPONSES WITH FUNGI LACKING PHENOLOXIDASES, GROUP IV

Time Reaction Recorded	Sample Size	Interpretation of Numbers	ENZYME IDENTIFIERS		SPOT TEST CORRELATORS					
			Laccase	Tyrosinase						
			Sy	Ty	Py	G	Gl	N	p-C	P
0 min	0	Reactions	0	0	0	0	0	0	0	0
5 min	5	Reactions	0	0	2	3	0	1	1	2
		% of Sample	0%	0%	40%	60%	0%	20%	20%	40%
		X_c^2			0.00	0.20	3.20	0.80	0.80	0.00
		Correlation			0	0	0	0	0	0
15 min	7	Reactions	0	0	3	4	1	2	4	2
		% of Sample	0%	0%	43%	57%	14%	29%	57%	29%
		X_c^2			0.00	0.00	3.57	2.29	0.00	2.29
		Correlation			0	0	0	0	0	0
30 min	11	Reactions	0	0	3	8	3	4	6	3
		% of Sample	0%	0%	27%	73%	27%	36%	55%	27%
		X_c^2			1.45	1.45	1.45	0.36	0.00	1.45
		Correlation			0	0	0	0	0	0

* = $0.05>P>0.01$

** = $P \leq 0.01$

TABLE VIII. SPECIES OF GROUP IV CONTAINING PEROXIDASE

Time Reaction Recorded	Total Group IV Size	No. of Species Containing Peroxidase	% of Group IV Containing Peroxidase	SPOT TEST CORRELATORS Positive Reactions Occurring in Air					
				Py	G	Gl	N	p-C	P
0 min	0	0	0%	0	0	0	0	0	0
5 min	5	4	80%	1	2	0	1	0	1
15 min	7	5	71%	2	2	1	2	3	1
30 min	11	7	64%	2	4	2	4	3	2

FIG. I. COMPARISON OF LACCASE AND TYROSINASE OXIDATION OF PYROGALLOL

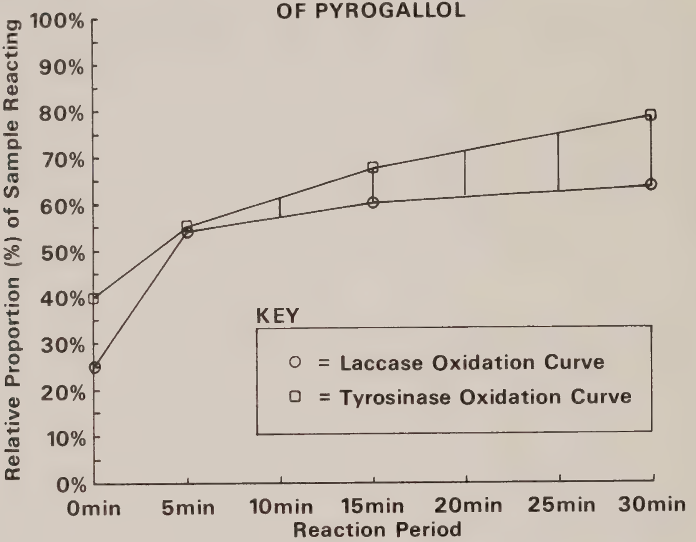


FIG. II. COMPARISON OF LACCASE AND TYROSINASE OXIDATION OF GUAIAC

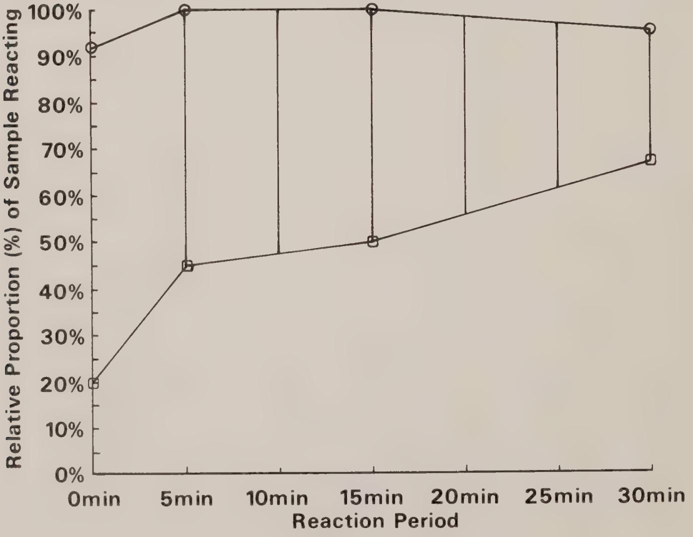


FIG. III. COMPARISON OF LACCASE AND TYROSINASE OXIDATION OF GUAIACOL

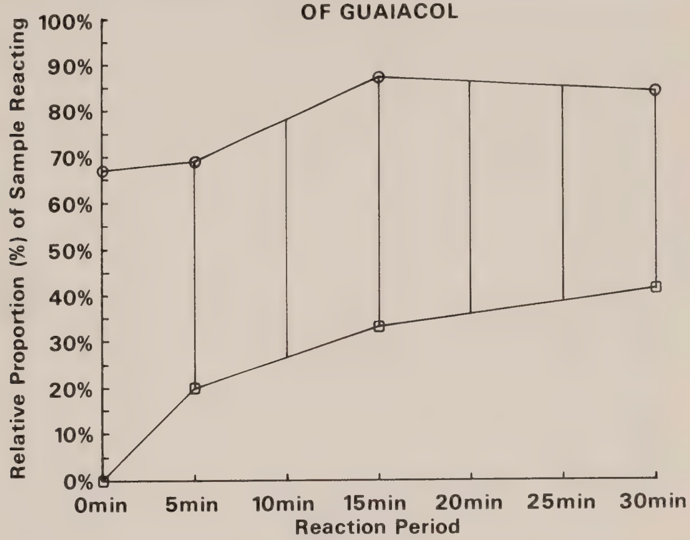


FIG. IV. COMPARISON OF LACCASE AND TYROSINASE OXIDATION OF 1-NAPHTHOL

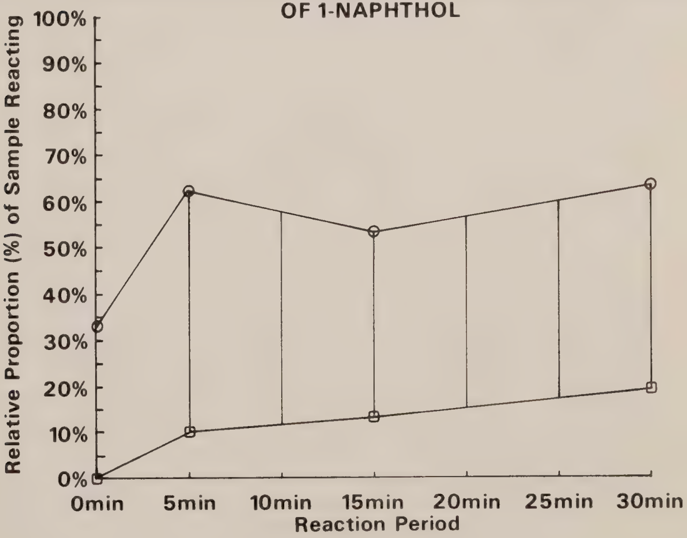


FIG. V. COMPARISON OF LACCASE AND TYROSINASE OXIDATION OF p-CRESOL

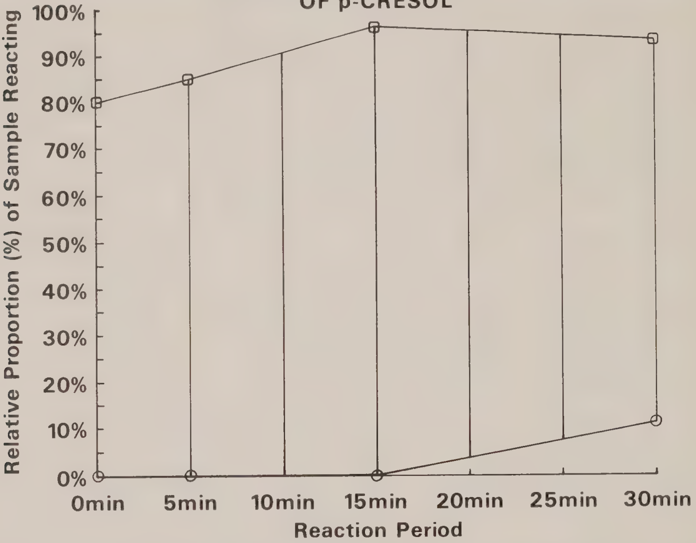


FIG. VI. COMPARISON OF LACCASE AND TYROSINASE OXIDATION OF PHENOL

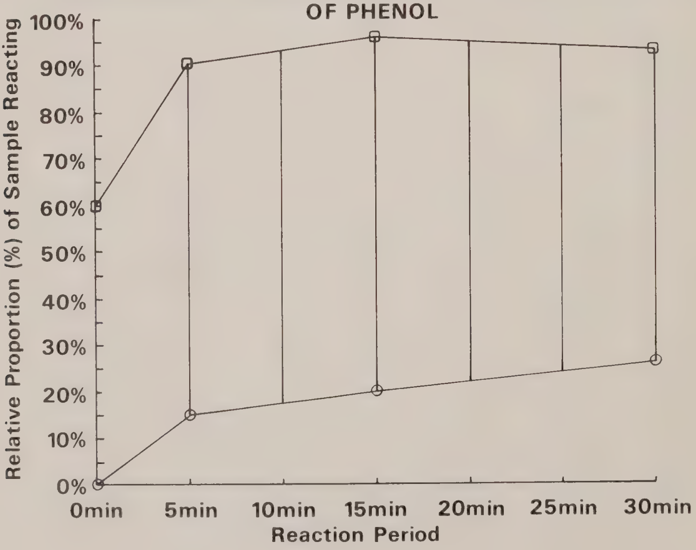


TABLE IX. LACCASE, TYROSINASE SUBSTRATE SPECIFICITY BASED ON LITERATURE

	LACCASE SUBSTRATE SPECIFICITY + = substrate oxidized - = substrate not oxidized	TYROSINASE SUBSTRATE SPECIFICITY + = substrate oxidized - = substrate not oxidized	SUBSTRATE SPECIFICITY EXCEPTIONS + = substrate oxidized - = substrate not oxidized
p-Cresol	- Ander & Eriksson 1976 Boidin 1951 Capellano & Demoulin 1969 Clutterbuck 1972 Higuchi & Kitamura 1953 Holubová-Jechová 1971 Käärik 1965 Kumari & Sirsi 1972 Matsubara & Iwasaki 1972 Schubert 1965	+ Ander & Eriksson 1976 Boidin 1951 Capellano & Demoulin 1969 Dawson & Magee 1955 Fåhraeus & Ljunggren 1961 Higuchi & Kitamura 1953 Higuchi 1958 Holubová-Jechová 1971 Käärik 1965 Lyr 1958 Matsubara & Iwasaki 1972 Nelson & Mason 1971 Sarkanen 1971 Schubert 1965 Yasunobu 1959	+ LACCASE (WHITE SOLID) Benfield et al. 1964 Blaich & Esser 1975 Dubernet et al. 1977 Fåhraeus 1961 Fåhraeus & Ljunggren 1961 Higuchi 1958 Küster & Little 1963 Lyr 1958 Sarkanen 1971 Schánĕl & Esser 1971
Guaiacol	+ Ander & Eriksson 1976 Blaich & Esser 1975 Boidin 1951 Capellano & Demoulin 1969 Demoulin 1967 Fåhraeus 1961 Fåhraeus & Ljunggren 1961 Higuchi 1958 Hoffmann & Esser 1977 Holubová-Jechová 1971 Käärik 1965 Küster & Little 1963 Lyr 1958 Sarkanen 1971 Schánĕl 1967 Schánĕl & Esser 1971 Schubert 1965 Turner 1974	- Ander & Eriksson 1976 Boidin 1951 Capellano & Demoulin 1969 Demoulin 1967 Holubová-Jechová 1971 Käärik 1965 Lyr 1958 Sarkanen 1971	+ TYROSINASE Higuchi 1958 Rösch 1961

TABLE IX. Continued

1-Naphthol	+ Ander & Eriksson 1976 Clutterbuck 1972 Fåhraeus 1961 Fåhraeus & Ljunggren 1961 Higuchi & Kitamura 1953 Käärik 1965 Kumari & Sirsi 1972 Lyr 1958 Schubert 1965 Ulezlo et al. 1975	- Ander & Eriksson 1976 Higuchi & Kitamura 1953 Käärik 1965 Lyr 1958 Schubert 1965 Yasunobu 1959	
Phenol	- Kumari & Sirsi 1972 Fåhraeus & Ljunggren 1961	+ Ander & Eriksson 1976 Dawson & Magee 1955 Käärik 1965 Yasunobu 1959	+ LACCASE Ander & Eriksson 1976 Fåhraeus 1961 Käärik 1965
L-Tyrosine	- Ander & Eriksson 1976 Boidin 1951 Demoulin 1967 Dubernet et al. 1977 Higuchi 1958 Käärik 1965 Kumari & Sirsi 1972 Küster & Little 1963 Lyr 1958 Matsubara & Iwasaki 1972 (nearly -) Sarkanen 1971 Schubert 1965 Turner 1974	+ Ander & Eriksson 1976 Boidin 1951 Dawson & Magee 1955 Decker 1977 Demoulin 1967 Higuchi 1958 Käärik 1965 Lyr 1958 Sarkanen 1971 Schubert 1965 Turner 1974 Yasunobu 1959	+ LACCASE Fåhraeus 1961 Matsubara & Iwasaki 1972 (slight oxidation)
Guaiac	+ Harkin & Obst 1973 Harkin et al. 1974 Kratochvil et al. 1971 Nobles 1958	+ Harkin & Obst 1973 Harkin et al. 1974 Kratochvil et al. 1971 Nobles 1958	
Syringaldazine	+ Harkin & Obst 1973 Harkin et al. 1974	- Harkin & Obst 1973 Harkin et al. 1974	
Pyrogallol	+ Ander & Eriksson 1976 Benfield et al. 1964 Blaich & Esser 1975 Clutterbuck 1972 Fåhraeus 1961 Higuchi 1958 Käärik 1965 Kumari & Sirsi 1972 Küster & Little 1963 Maehly & Chance 1954 Matsubara & Iwasaki 1972 Schánĕl & Esser 1971 Schubert 1965 Ulezlo 1975	+ Ander & Eriksson 1976 Higuchi 1958 Käärik 1965 Yasunobu 1959	- LACCASE Koenigs 1970

LITERATURE CITED

Ander, P. and K. E. Eriksson. 1976. The importance of phenol oxidase activity in lignin degradation by the white-rot fungus *Sporotrichum pulverulentum*. Arch. Microbiol. 109: 1-8.

Benfield, G., Sheila M. Bocks, K. Bromley, and B. R. Brown. 1964. Studies of fungal and plant laccases. Phytochem. 3: 79-88.

Blaich, R. and K. Esser. 1975. Function of enzymes in wood destroying fungi: II. Multiple forms of laccase in white rot fungi. Arch. Microbiol. 103: 271-277.

Boidin, J. 1951. Recherche de la tyrosinase et de la laccase chez les Basidiomycètes en culture pure. Milieux différentiels. Intérêt systématique. Rev. d. Mycol. 16: 173-197.

Capellano, A. and V. Demoulin. 1969. Nouvelles recherches sur la distribution des phénoloxydases et des peroxydases chez les Gastéromycètes. Bull. Soc. Myc. Fr. 85: 251-254.

Christman, R. F. and R. T. Oglesby. 1971. Microbiological degradation and the formation of humus. In, Lignins. K. V. Sarkanen and C. H. Ludwig, eds. Wiley-Interscience, N.Y. pp. 769-795.

Clutterbuck, A. J. 1972. Absence of laccase from yellow-spored mutants of *Aspergillus nidulans*. J. Gen. Microbiol. 70: 423-435.

Davidson, R. W., W. A. Campbell, and Dorothy J. Blaisdell. 1938. Differentiation of wood-decaying fungi by their reactions on gallic or tannic acid medium. J. Agr. Res. 57: 683-695.

Dawson, C. R. and R. J. Magee. 1955. Plant tyrosinase. In, Methods in Enzymology. Vol. II. S. P. Colowick and N. O. Kaplan, eds. Academic Press, N.Y. pp. 817-827.

Decker, Lillian A. (ed.). 1977. Worthington Enzyme Manual. Worthington Biochemical Corp., Freehold, N.J. pp. 66-76.

Demirevska-Kepova, K. N. and N. T. Bakardjieva. 1976. Study on competition between guaiacol and ascorbic acid in peroxidase reaction and on ion effect by means of absorption spectra. Can. J. Bot. 54: 90-99.

Demoulin, V. 1967. Proposition d'un processus de détection des phénoloxydases et peroxydases chez les macromycètes. Application à quelques Gastéromycètes. Planta 76: 129-137.

Dubernet, M., P. Ribereau-Gayon, H. R. Lerner, E. Harel and A. M. Mayer. 1977. Purification and properties of laccases from *Botrytis cinerea.* Pytochem. 16: 191-193.

Fåhraeus, G. 1961. Monophenolase and polyphenolase activity of fungal laccase. Biochim. Biophys. Acta. 54: 192-194.

__________ and H. Ljunggren. 1961. Substrate specificity of a purified fungal laccase. Biochim. Biophys. Acta. 46: 22-32.

Guilford, J. P. 1965. Fundamental Statistics in Psychology and Education. 4th ed. McGraw-Hill, N.Y. pp. 237-238.

Gutteridge, S. and D. Robb. 1975. The catecholase activity of *Neurospora* tyrosinase. Eur. J. Biochem. 54: 107-116.

Harkin, J. M., M. J. Larsen and J. R. Obst. 1974. Use of syringaldazine for detection of laccase in sporophores of wood rotting fungi. Mycologia 66: 469-476.

__________ and J. R. Obst. 1973. Syringaldazine, an effective reagent for detecting laccase and peroxidase in fungi. Experientia 29: 381-387.

Hidaka, T. 1976. Reevaluation study of mushroom tyrosinase-tyrosine metabolites by means of gas chromatography and mass spectrometry. I. Identification of 2-carboxy-5, 6-dihydroxyindole. Kurume Med. J. 23: 49-56.

Higuchi. T. 1958. Further studies on phenol oxidase related to the lignin biosynthesis. J. Biochem. 45: 515-528.

__________ and K. Kitamura. 1953. Biochemical study of wood-rotting fungi. II. Relation between Bavendamm's reaction and tyrosinase. J. Japan Forestry Soc. 35: 350-354.

Hintikka, V. 1970. Studies on white-rot humus formed by higher fungi in forest soils. Comm. Instit. Forest. Fenn. 69: 1-68.

Hoffmann, P., and K. Esser. 1977. The phenol oxidases of the Ascomycete *Podospora anserina* XII. Affinity of laccases II and III to substrates with different substitution patterns. Arch. Microbiol. 112: 111-114.

Holubová-Jechová, Věra. 1971. Polyphenoloxidase enzymes from wood-inhabiting Hyphomycetes. Česká Mykol. 25: 23-32.

Käärik, Aino. 1965. The identification of the mycelia of wood-decay fungi by their oxidation reactions with phenolic compounds. Stud. Forest. Suecia 31: 1-81.

Koenigs, J. W. 1970. Peroxidase activity in brown-rot Basidiomycetes. Arch. Mikrobiol. 73: 121-124.

__________. 1972. Production of extracellular hydrogen peroxide and peroxidase by wood-rotting fungi. Phytopath. 62: 100-110.

Kratochvil, J. F., R. H. Burris, Margaret K. Siekel, and J. M. Harkin. 1971. Isolation and characterization of α-guaiaconic acid and the nature of guaiacum blue. Phytochem. 10: 2529-2531.

Kumari, H. Lalitha, and M. Sirsi. 1972. Purification and properties of laccase from *Ganoderma lucidum*. Arch. Mikrobiol. 84: 350-357.

Küster, E. and B. T. Little. 1963. Role of phenolases in the formation of quinonoid fungal metabolic products of *Aspergillus fumigatus* Fres. and *Penicillium spinulosum* Thom. Biochim. Biophys. Acta. 67: 288-294.

Lamaison, J. L. 1976. Intérêt chimiotaxinomique de l'équipement enzymatique des macromycètes. Bull. Soc. bot. Fr. 123: 119-136.

Lerner, A. B. and T. B. Fitzpatrick. 1950. Biochemistry of melanin formation. Physiol. Rev. 30: 91-126.

Lyr, H. 1958. Über den nachweis von oxydasen und peroxydasen bei höheren pilzen und die bedeutung dieser enzyme für die Bavendamm-reaktion. Planta 50: 359-370.

Maehly, A. C. and B. Chance. 1954. The assay of catalases and peroxidases. In, Methods of Biochemical Analysis. Vol. I. D. Glick, ed. Wiley-Interscience, N.Y. pp. 357-408.

Matsubara, T. and H. Iwasaki. 1972. Occurrence of laccase and tyrosinase in fungi of Agaricales and comparative study of laccase from *Russula delica* and *R. pseudodelica*. Bot. Mag. (Tokyo) 85: 71-83.

Nelson, Rita M. and H. S. Mason. 1970. Tyrosinase (Mushroom). In, Methods in Enzymology. Vol. XVIIA. H. Tabor and C. W. Tabor, eds. Academic Press, N.Y. pp. 626-632.

Nobles, Mildred K. 1958. A rapid test for extracellular oxidase in cultures of wood-inhabiting Hymenomycetes. Can. J. Bot. 36: 91-99.

__________. 1971. Cultural characters as a guide to the taxonomy of the Polyporaceae. In, Evolution of the Higher Basidiomycetes. Univ. of Tenn. Press, Knoxville. pp. 169-196.

Noller, C. R. 1957. Chemistry of Organic Compounds. Saunders, Philadelphia. p. 505.

Rösch, R. 1961. Untersuchungen über den lignin-abbau und über die oxydasen von braun- und weissfäulepilzen. Arch. Mikrobiol. 38: 73-106.

Sarkanen, K. V. 1971. Precursors and their polymerization. In, Lignins. K. V. Sarkanen and C. H. Ludwig, eds. Wiley-Interscience, N.Y. pp. 95-163.

Saunders, B. C. 1973. Peroxidases and catalases. In, Inorganic Biochemistry. Vol. 2. G. L. Eichhorn ed. Elsevier, N.Y. pp. 988-1021.

Schánĕl, L. 1967. A new polyphenoloxidase test for distinguishing between wood-rotting fungi. Biol. Plantarum 9: 41-48.

__________ and K. Esser. 1971. The phenoloxidases of the Ascomycete *Podospora anserina*. VIII. Substrate specificity of laccases with different molecular structures. Arch. Mikrobiol. 77: 111-117.

Schubert, W. J. 1965. Lignin Biochemistry. Academic Press, N.Y. pp. 77-119.

Singer, R. 1975. The Agaricales in Modern Taxonomy. 3rd ed. Cramer, Vaduz. 912 p.

Smith, P. I. and G. A. Swan. 1976. A study of the supposed hydroxylation of tyrosine catalyzed by peroxidase. Biochem. J. 153: 403-408.

Stafford, H. A. 1974. The metabolism of aromatic compounds. Ann. Rev. Plant Physiol. 25: 459-486.

Turner, Elizabeth M. 1974. Phenoloxidase activity in relation to substrate and development stage in the mushroom, *Agaricus bisporus*. Trans. Br. Mycol. Soc. 63: 541-547.

Ulezlo, I. V., T. M. Uporova and R. V. Feniksova. 1975. Study of oxidative enzymes of the lignin-degrading fungus *Pleurotus ostreatus*. Prikl. Biokhim. Mikrobiol. 11: 535-538.

Watling, R. 1971. Chemical tests in Agaricology. In, Methods in Microbiology. Vol. 4. C. Booth, ed. Academic Press, N.Y. pp. 567-597.

Westerfeld, W. W. and C. Lowe. 1942. The oxidation of p-cresol by peroxidase. J. Biol. Chem. 145: 463-470.

Wickerham, L. J. and C. P. Kurtzman. 1975. Synergistic color variants of *Aureobasidium pullulans*. Mycologia 67: 342-361.

Yasunobu, K. T. 1959. Mode of action of tyrosinase. In, Pigment Cell Biology. M. Gordon, ed. Academic Press, N.Y. pp. 583-608.

Young, Maria and C. Steelink. 1973. Peroxidase catalyzed oxidation of naturally-occurring phenols and hardwood lignins. Phytochem. 12: 2851-2861.

Zar, J. H. 1974. Biostatistical Analysis. Prentice-Hall. Englewood Cliffs, N.J. p. 49.

MYCOTAXON

Vol. IX, No. 1, pp. 277-284 June 12, 1979

TWO NEW SPECIES AND NEW RECORDS OF *TULOSTOMA* FROM THE PACIFIC NORTHWEST[1]

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SUMMARY

Two new species of *Tulostoma*, *T. stuntzii* and *T. ferrugineum* are described. Eight additional species are recognized, six of which are new records for the Pacific Northwest.

INTRODUCTION

Work on *Tulostoma* has been limited in North America and is lacking for the Pacific Northwest. Basic publications available for North America are Morgan (1890), White (1901), Lloyd (1903, 1906), Coker and Couch (1928), Johnson (1929), Long (1944, 1946a, 1946b, 1947), Smith (1951), Herrera (1959), and Wright et al. (1972).

In *Tulostoma*, as in many genera of Gasteromycetes, species are difficult to separate because of the small number of reliable characteristics available. An excellent discussion and evaluation of specific characters used in the taxonomy of *Tulostoma* is provided by Wright (1955). The characters we stress basically follow his ideas. In descriptions, color terms followed by brackets refer to specific swatches in Kornerup and Wanscher (1962).

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[1] Portion of a dissertation by the senior author to the Graduate School of Central Washington University for the degree of Master of Science.

Material examined, unless otherwise indicated, is stored in Central Washington University (CWU) herbarium. This paper is the first report from a survey begun in 1969 by Hosford and a subsequent taxonomic study by Oliver.

Tulostoma stuntzii Oliver and Hosford, Sp. Nov.

Fig. 1

GASTEROCARPIA nana, crassa, 1.7-1.8 cm alta. SPOROTHECA subglobosa, e globosa ad depresso-globosam varians, 9-12 mm alta, 13-14 mm lata. EXOPERIDIUM cinereum, granulosum, ex parte secedens praeter vaginam peridialem 1 mm crassam, 4-7 mm latam, compactam. ENDOPERIDIUM cinnamomeum aetate albidum, membranaceum, ex leve ad aliquantum foveatum varians. OSTIOLUM prominens, tubulosum 1-1.5 mm altum, orificium 1-3 mm diam. STIPES albus, brevis atque crassus, 5-9 mm altus, 4-8 mm latus, cupulam basalem praebens. SPORAE 5-6 (-7) µm *diam., e globosis ad subglobosam virians, subtiliter echinulatae interdum apiculate. HABITATIO in solo arenoso.*

Holotypus Hosford 1594 prope oppido Vantage lectus, in herbario CWU conservatus.

Etymology: In honor of Professor Daniel E. Stuntz.

GASTEROCARP small, stout, 1-7 to 1.8 cm tall. *SPORE CASE* subglobose to depressed globose, 9-12 mm tall × 13-14 mm wide. *EXOPERIDIUM* gray in color, granular, deciduous except for a 1 mm thick, tightly compact peridial sheath, 4-7 mm wide, which flakes off in pieces. *ENDOPERIDIUM* light brown (6D6-6D7), becoming dull white in age; membranous, smooth to somewhat pitted; composed of two loosely defined layers: an outer layer composed of more or less gelatinized hyphae interspersed with thick walled hyphae, intergrading with an inner layer composed of tightly intertwined thick walled hyphae similar to the glebal capillitia. *MOUTH* prominent, tubular, 1-1.5 mm tall, the opening varying from 1-3 to 2-3 mm in diameter; concolorous with endoperidium.

STIPE short, stout, 5-9 mm tall × 4-8 mm wide with a slight taper toward the apex; white in color, striate to deeply furrowed; base broad, rounded, enclosed in a sand cup, no radiating base present. *COLLAR* indistinct, in most covered by peridial sheath; when visible, smooth.

SPORE range 4.5-6 (-7) µm in diam., averaging 5.7 µm, globose to subglobose, finely echinulate with spines extending into a thin hyaline layer surrounding the spore; some apiculate; yellow brown in 3% KOH or water, acyanophilous in cotton blue (Aniline Blue) and generally no reaction with Melzer's, except for an occasional spore which darkens. *CAPILLITIA* rare, when present, hyaline, 4-7 μm wide, smooth lacking crystalline incrustations and thick walled; septa rare, when present, joints slightly swollen to 5-10 μm wide (refer to type 1 of Wright, 1955).

HABIT, HABITAT, SEASON: growing solitary in sand, semi-stabilized dune areas, growing with *Chrysothamnus* spp. Fall species.

MATERIAL EXAMINED: WASHINGTON: *Kittitas Co.*, near town of Vantage, Hosford 1594 (type). *Grant Co.*, Powerline Rd., Oliver 14.

DISCUSSION: This species has been collected in the fall in Central Washington and is distinguished by its small stature, cinnamon brown endoperidium, and weakly echinulate spores. *T. stuntzii* is closely related to *T. simulans* and *T. jourdani*. It may be distinguished from *T. simulans* by its smaller stature and stipe, and its echinulate rather than verrucose spores; it differs from *T. jourdani* by its somewhat darker endoperidial color, smaller stature, and echinulate rather than smooth spores.

Tulostoma ferrugineum Oliver and Hosford, Sp. Nov.

Figs. 2, 3

GASTEROCARPIA 3-6.5 cm alta, SPOROTHECA subglobosa, e globosa ad depresso-globosam varians, 7.5-10 mm alta, 10-13 mm lata. EXOPERIDIUM granulosum, ex strato tenui arenae atque hyphae constatum, mox secedens, solum vagina peridialis 3-4 mm lata remanens. ENDOPERIDIUM tenax, membraneceum, brunneocinereum. OSTIOLUM tubulosum, brevis, 1 mm altum, zona distincta cinerea basim tubi cingenti. STIPES ferrugineus, manifeste squamulosus, 2.2-5.5 cm altus, 3.4 mm latus, cupula bulbosa basali. SPORAE 5-6 (-7) μm diam., e globosis ad subglobosam varians, valde verrucosae verrucis truncatis. CAPILLITIA hyalina, 4-9 μm lata, levitunicata. HABITATIO in solo arenoso.
HOLOTYPUS Oliver 145, in junipereto ad septentriones opidii Pasco lectus, in herbario CWU conservatus.

Etymology: Latin, *ferrugineum*, referring to the conspicuously rusty brown stipe.

GASTEROCARP medium, 3-6.5 cm tall, consisting of peridium, stipe, and a bulbous to diffuse base. *SPORE CASE* subglobose to depressed globose, 7.5-10 mm tall × 10-13 mm wide. *EXOPERIDIUM* granular, composed of a thin layer of sand and entangled, thick-walled hyphae, soon retreating leaving only a basal peridial sheath, 3-4 mm wide. *ENDOPERIDIUM* tough membranous, composed of intertwined thick walled, septate hyphae; brownish gray (5C3-5D3 to 6C2-6D2). *MOUTH* tubular, short, 1 mm tall, the opening 1 mm in diam.; a distinct gray (6C1) endoperidial zone, 1-1.5 mm wide, is present around the base of the tube, tending to fade in age.

STIPE 2.2-5.5 cm tall × 3-4 mm wide, even to slightly tapering at apex; reddish brown (7E4-8E4), distinctly squamulose; base bulbous, diffuse from large conglomeration of sand, hyphae and roots, and occasionally radiating. *COLLAR* indistinct.

SPORE range 5-6 (-7) µm in diam., averaging 5.5 µm, globose to subglobose; strongly verrucose, warts flat-topped (truncated), extending into an amorphous hyaline layer; a partial reticulum evident in optical section; yellow brown in 3% KOH or water, acyanophilous in cotton blue and no reaction with Melzer's. *CAPILLITIA* hyaline, 4-9 µm wide, smooth walled, lacking crystalline deposits and thick walled; frequently branched and septate, joints often swollen to 6-12 µm wide and yellowish (Type 1 - Wright, 1955).

HABIT, HABITAT, SEASON: growing solitary to gregarious in semi-stabilized dune areas, in protected hollows, associated with *Chrysothamnus* spp. and other shrubs. Late Winter and Spring.

MATERIAL EXAMINED: WASHINGTON: *Franklin Co.*, Juniper Forest north of Pasco, Oliver 145 (type), 146, 206.

DISCUSSION: *T. ferrugineum* is recognized by the presence of a distinct gray zone below a prominent tubular mouth, reddish brown, scaly stipe, spores with truncated verrucae and habitat. It appears to be closely related to the European *T. brumale* complex, but differs from these by its lack of crystalline deposits on capillitia (as reported by European workers), truncated verrucae rather than aculeate ornamentation, and sandy habitat. The most closely related species in the complex seems to be *T. melanocyclum*, a rare species sometimes associated with *T. brumale*.

DISTRIBUTION DATA ON PREVIOUSLY DESCRIBED SPECIES

1. *Tulostoma campestre* Morgan

Additional collections: OREGON: *Multnomah Co.*, along Columbia River, Hosford 2159 (Oswald Collection). WASHINGTON: *Asotin Co.*, near Clarkston, WSU-1265 (WSU). *Yakima Co.*, Sunnyside, Ebenal 1, 35, 59, 60, 80, 97, 98, 217, 218, 221, 222, 259, Hosford 1583, 1836, Oliver 216, 217, 218; Wapato, Oliver 214, 215.

A fairly common species in northern United States. Previously reported from Wisconsin, South Dakota, Nebraska, Colorado, the District of Columbia, and Ontario, Canada.

2. *Tulostoma fibrillosum* White

Additional collections: IDAHO: *Ada Co.,* Boise, Trueblood 5830. WASHINGTON: *Franklin Co.,* Juniper Forest north of Pasco, Oliver 113, 133, 138, 139, 142b, 144. *Grant Co.,* near Beverly, Scates 2836. *Whitman Co.,* Wanawai, WSU-56747 (WSU).

Previously known from Michigan and Ontario, Canada.

3. *Tulostoma jourdani* Pat. sensu Long (1947)

Additional collections: OREGON: *Harney Co.,* Rattle Snake Butte, Malheur National Wildlife Refuge, Oliver 187 (Trappe Collection). WASHINGTON: *Franklin Co.,* Juniper forest north of Pasco, Ebenal 47, 80B, Oliver 127, 130, 131, 132, 134, 135, 142A, 143, 147, 148, 151, 152, 200, 205, 210. *Grant Co.,* Crab Creek, Oliver 182; Priest Lake Dam, Hosford 1466; near Vantage, Hosford 1567, 1574, 1578, 1585, 1592, Oliver 26; Summer Falls, Hosford 1872.

The most common and widespread species of *Tulostoma* in the Pacific Northwest. This species shows great variability in size of sporocarps and degree of spore ornamentation, believed due to environmental conditions.

4. *Tulostoma poculatum* White

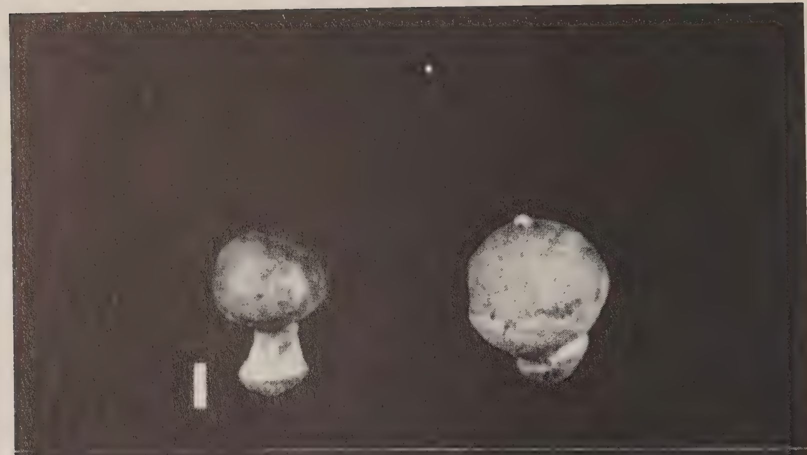
Additional collections: OREGON: *Wallowa Co.,* near Wallowa Lake, WSU-32482 (WSU). WASHINGTON: *Grant Co.,* Vantage, Hosford 1591, Scates 2833. *Benton Co.,* Prosser, WSU-32493 (WSU).

Previously reported from Arizona, Alabama, Colorado, Indiana, Nebraska, New Mexico, Texas, and Washington. A widely distributed species but seldom collected in numbers.

5. *Tulostoma simulans* Lloyd

Additional collections: IDAHO: *Latah Co.,* near Genesee, WSU-23344 (WSU). *Valley Co.,* McCall, WSU-52713 (WSU).

This species is distributed throughout the United States and is especially common in the Midwest. In Central Washington it is very difficult to distinguish *T. simulans* from *T. jourdani.* A considerable amount of additional work is needed to clarify this complex of species.



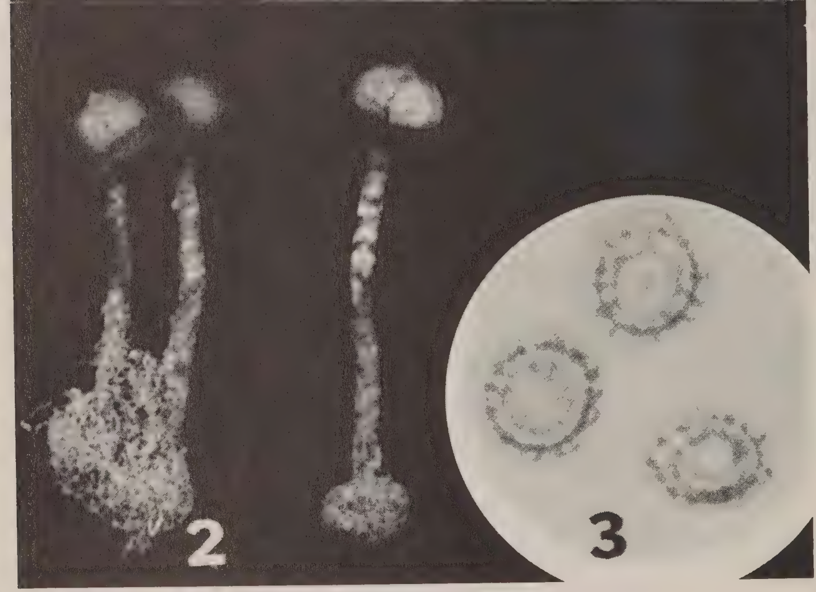


Fig. 1. *Tulostoma stuntzii*, × 1.3 (Hosford 1594, holotype).

Figs. 2-3. *Tulostoma ferrugineum* (Oliver 145, holotype).
2. Gasterocarps, × 1.
3. Basidiospores, 5-6 μm diam.

6. *Tulostoma striatum* Conn.

Additional collections: CALIFORNIA: *Marin Co.*, San Anselmo, Mills 1216 (identified as *T. berteroanum* Lev., WSU-52772). *Stanislaus Co.*, Turlock, Oliver 238 (D. Gottelli Collection). OREGON: *Lake Co.*, near Plush, Oliver 236. WASHINGTON: *Chelan Co.*, along Columbia River near Wenatchee, WSU-23721 (WSU).

This is one of the most easily recognized species due to its striate spores. Although considered uncommon, this species is widely distributed in the west.

7. *Tulostoma tuberculatum* White

Additional collections: IDAHO: *Butte Co.*, Craters of the Moon National Park, WSU-20417 (WSU). *Owyhee Co.*, Marsing, Trueblood 5757; Rabbit Creek, Trueblood 5821.

Previously reported from Washington, Texas, Illinois, and Ohio. This species might be more properly placed under *T. granulosum* as proposed by J. E. Wright.

8. *Tulostoma verrucosum* Morgan

Additional collections: OREGON: *Benton Co.*, Corvallis, Lloyd 28941 (Lloyd Collections).

This is the only known report of the species in the Pacific Northwest based on a collection sent to Lloyd by S. M. Zeller.

ACKNOWLEDGEMENTS

The authors wish to thank C. G. Shaw of Washington State University for loan of herbarium specimens. Also thanks is given to Kit Scates, John Ebenal, Ellen Trueblood, Dr. William Barker, and Lee Hoppis for field collections. Finally we express our appreciation to Dr. J. M. Trappe for his constructive criticisms of the manuscript and to Dr. D. E. Stuntz for his help with the Latin diagnoses.

LITERATURE CITED

Coker, W.C. and J.N. Couch. 1928. Gasteromycetes of Eastern United States and Canada. Univ. North Carolina Press. Chapel Hill. 201 pp.

Herrera, T. 1959. *Batterraea* Y *Tylostoma* en El Valle De Mexico. Sobretiro de los Anales del Instituto de Biologia. 30:21-33.

Johnson, Minnie May. 1929. The Gasteromycetae of Ohio: Puffballs, Bird's Nest Fungi and Stinkhorns. Ohio Biol. Surv. Bull., No. 22. 4(7):271-352.

Kornerup, A. and J.H. Wanscher. 1962. Reinhold Color Atlas. Reinhold Publ. Corp. New York. 224 pp.

Lloyd, C.G. 1903. The Tylostomeae. Mycological Notes. 1(14):133-136.

________. 1906. The Tylostomeae. Mycological Writings. 2:9-26.

________. 1923. *Tylostoma finkii* from Professor Bruce Fink, Ohio. Mycological Notes. 7(68):1169.

Long, W.H. 1944. Studies in the Gasteromycetes X. Seven New species of *Tylostoma*. Mycologia 36:318-339.

________. 1946a. Studies in the Gasteromycetes XII. Five species of *Tylostoma* with membranous exoperidia. Mycologia 38:77-90.

________. 1946b. Studies in the Gasteromycetes XIII. The types of Miss White's species of *Tylostoma*. Mycologia 38:171-179.

________. 1947. Studies in the Gasteromycetes XV. Notes on new or rare species of *Tylostoma*. Lloydia 10:115-135.

Smith, A.H. 1951. Puffballs and their allies in Michigan. Univ. of Mich. Press. Ann Arbor, Mich. 131 pp., 43 Pls.

White, V.S. 1901. The Tylostomaceae of North America. Bull. Torrey Bot. Club 28:421-444.

Wright, J.E. 1955. Evaluation of specific characters in the genus *Tulostoma* Pers. Papers of the Mich. Acad. Sci., Arts, Letters 40:79-87.

Wright, J.E., T. Herrera, and G. Guzmán. 1972. Estudios sobre el género *Tulostoma* in Mexico. Ciencia (Mex.) 27:109-122.

MYCOTAXON

Vol. IX, No. 1, pp. 285-296 June 12, 1979

THE GENUS SUILLUS IN THE WESTERN UNITED STATES

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SUMMARY

A taxonomic key is presented to the forty species of Suillus occurring in the western United States. Short descriptions of each species are also included.

Species belonging to the genus Suillus (Boletaceae) constitute a common and often dominant element of the bolete flora of the western United States, and may be expected to occur wherever certain members of the Pinaceae are growing. This genus of fleshy fungi is characterized by a yellow, tubulose hymenophore with concolorous (rarely gray brown or pinkish) pores that vary in diameter from very small (less than 1 mm) to radially elongate or lamellose and reach 3-5 mm. In addition clustered cystidia, which typically stain brown in dilute solutions of potassium hydroxide, are often present and may be found on the surface of the stipe as well as on the pores. There is usually a viscid pellicle on the pileus surface, and the spores are smooth and olive brown in mass. There are several species which vary from the above description by having a dry, often squamulose to fibrillose pileus or by the absence of the clustered cystidia. Such species are characteristically annulate and possess radiately elongate pores. Only a relatively few Suillus species show the blue discoloration of the context when exposed or bruised that is so often seen in other genera of boletes. None are known to be toxic to man, but, unfortunately, none are considered as truly desirable esculents.

The almost complete restriction of these boletes to mycorrhizal associations with pines and related conifers has led to considerable speculation concerning their origin and phylogenetic relationships with other groups of boletes. Species of pines (*Pinus*), larch (*Larix*), Douglas fir (*Pseudotsuga*) and spruce (*Picea*) are the most common mycorrhizal hosts and firs (*Abies*) and other genera are rarely, if ever, involved. No fruiting of these fungi has been observed under species belonging to the Cupressaceae and Taxodiaceae which are generally considered to be endomycorrhizal, and, similarly, no fruitings have been observed under any hardwoods except possibly *Suillus anomalus* which has been found in the vicinity of oaks and madrones, but ponderosa pines were also in the vicinity. There are numerous endemic species of this genus in the west, resulting, perhaps at least in part, from the unusually large number of endemic pines and other conifers also present. Many *Suilli* show such severe restriction of mycorrhizal hosts that only a single species of conifers is involved as evidenced by *S. caerulescens*, *S. imitatus*, *S. ponderosus* and *S. lakei* all of which are confined to Douglas fir, at least in this region. Some species, on the other hand, enjoy a much broader spectrum of associates.

The area included within this report includes all of the states bordering on or located west of the Rocky Mountains. In this region a total of 40 species has been recorded. No new species are presented in this paper, but it must not be assumed that the flora is thoroughly explored. Indeed, there are numerous areas in which little or no collecting has been done and in which the potential for the existence of undescribed taxa is quite high.

KEY TO SPECIES

1. Pileus dry to moist, or if viscid, then stipe annulate and glandular dots absent..........................2

1. Pileus subviscid to viscid or glutinous. Stipe and/or pores with glandular dots..........................9

2. Pileus dry to moist, fibrillose to tomentose or squamulose....................................3

2. Pileus viscid or subviscid, glabrous to streaked or with scattered appressed fibrils or obscurely fibrillose scaly.......................... 4

3. Stipe hollow. Clamp connections present.
.................*S. cavipes*

Pileus moist to dry, fibrillose to fibrillose squamulose, dull yellow to reddish brown, margin appendiculate. Tubes yellow, radiating. Stipe often with slight annulus. Spores 7-10 x 3.5-4 um. Cystidia solitary. Cuticle a trichodermium. Larch.

3. Stipe solid. Clamp connections absent.
.................*S. lakei*

Pileus dry, fibrillose scaly, gelatinous layer beneath fibrils, pink to reddish, margin often appendiculate. Tubes yellow. Stipe annulate. Context sometimes bluing. Spores 8-11 x 3-4 um. Cystidia solitary or clustered. Cuticle a basal layer of gelatinous hyphae subtended by clusters of erect fascicles of hyphae. Douglas fir.

4. Context in base of stipe changing to blue when exposed...5

4. Context in base of stipe unchanging or not becoming blue when exposed...............................7

5. Annulus well developed, colored orange to yellow orange and viscid on outer (lower) surface
..................*S. ponderosus*

Pileus glabrous, reddish brown, margin often appendiculate, sometimes with green stains when old. Tubes yellow. Stipe annulate. Spores 8-10 x 3.8-5 um. Cystidia solitary or clustered. Cuticle an ixotrichodermium. Douglas fir.

5. Annulus not as described above......................6

6. Pileus cinnamon to reddish cinnamon, glabrous. ....*S. imitatus*

Pileus glutinous. Tubes yellow. Stipe annulate. Spores 7-9 x 4-4.5 um. Cystidia solitary or clustered. Cuticle an ixotrichodermium. Douglas fir.

6. Pileus paler in color, with scattered fibrils or streaked with gluten..........*S. caerulescens*

Pileus viscid, margin often appendiculate. Tubes boletinoid, yellow. Stipe annulate, annulus moist to subviscid, white to pallid. Spores 8-11 x 3-5 um. Cystidia solitary or clustered. Cuticle an ixotrichodermium. Douglas fir.

7. Context of pileus changing to blue then fuscous when exposed.........................*S. lithocarpi-sequoiae*

Pileus glabrous, viscid, pallid to reddish brown (variegated). Tubes yellow. Stipe annulate. No glandulae. Spores 7.5-9.8 x 3.2-3.8 um. Cystidia solitary or clustered. Cuticle an ixotrichodermium. No fresh material examined. Tanbark oak (?) and Sequoia (?).

7. Context of pileus not changing as described above 8

8. Context of pileus bright yellow, changing to pink or flesh color when exposed. Associated with larch. ....*S. grevillei*

Pileus glutinous, glabrous, often brownish then yellow. Tubes yellow. Stipe annulate, pallid, viscid outer surface. Spores 8-10 x 2.8-3.5 um. Cystidia clustered. Cuticle an ixotrichodermium. Larch.

8. Context pale yellow to pallid, unchanging. Associated with firs (Abies).............*S. appendiculatus*

Pileus glabrous, yellow, dry, margin appendiculate. Tubes yellow. Stipe non glandulose, yellow. Spores 7.5-9.5 x 3-3.5 um. Cystidia solitary or clustered. Cuticle an ixotrichodermium. Firs.

9. Basidiocarps gastroid, i.e., pileus expanding only slightly and irregularly. Stipe often poorly developed and pores frequently large and irregular 10

9. Basidiocarps not gastroid........................12

10. Pileus covered with a white fibrillose veil that breaks into patches or squamules as pileus expands. ....S. albivelatus

Pileus viscid, buff to brown, margin appendiculate. Tubes yellow. Stipe white, glandulae absent or obscure. Slight annulus sometimes present. Spores 7-8.5 x 2.8-3 um. Cystidia clustered. Cuticle an ixotrichodermium. Western white pines.

10. Veil absent or not persisting as above............11

11. Pileus bright yellow. Stipe short, often eccentric and/or poorly developed.........S. megaporinus

Pileus viscid, fibrillose to fibrillose scaly, buff to pale ochraceous, scales darker, margin appendiculate. Tubes yellow, pores up to 5 mm long and 3 mm broad, lamellose. Stipe often short and eccentric, glandulose, no annulus but fibrillose zone often present. Spores 8.5-10.5 x 4.5-6 um. Cystidia clustered. Cuticle an ixotrichodermium Lodgepole pines.

11. Pileus yellow brown. Stipe central, well developed. ....S. riparius

Pileus viscid, glabrous then rimose to areolate-scaly, brown then dark yellow, margin with conspicuous roll of cottony tissue. Tubes yellow, pores up to 3 mm in diam. Stipe glandulose, no annulus but fibrillose zone sometimes present. Spores 8-11 x 3.2-5 um. Cystidia clustered. Cuticle an ixotrichodermium. Pines.

12. Pores greater than 1 mm in diameter, sometimes radiately arranged................................13

12. Pores not exceeding 1 mm in diameter..............18

13. Annulus present.....................................14

13. Annulus absent......................................15

14. Pileus colored pinkish cinnamon to vinaceous brown. Context white.................S. punctatipes

Pileus viscid, glabrous and streaked, brown to dark brown, margin glabrous. Tubes yellow, pores radiately arranged. Stipe glandulose, no annulus. Spores 7.5-9 x 3-4 um. Cystidia clustered. Cuticle an ixotrichodermium. Pines.

14. Pileus colored deep olive buff, umbonate. Context yellow........................S. umbonatus

Pileus viscid, streaked, pale tan to pale yellow, often darkening with age, margin appendiculate. Tubes yellow, pores 2-3 mm long. Stipe annulate, glandulose (more obvious when old). Spores 7-11 x 3.5-4.5 um. Cystidia clustered. Cuticle an ixotrichodermium Lodgepole pines.

15. Basidiocarps robust. Pileus up to 10 cm broad; stipe up to 10 cm long and 5 cm broad. Tubes strongly decurrent...........S. anomalus

Pileus viscid, yellow brown to dark brown, glabrous or streaked, margin with cottony roll. Tubes yellow, pores 1-1.5 mm wide. Stipe infrequently glandulose. No veils. Spores 6.5-10.5 x 3-4 um. Cystidia clustered. Cuticle an ixotrichodermium. Mixed woods: oaks, madrones and ponderosa pine.

15. Basidiocarps not possessing the combination of characters described above.........................16

16. Pileus margin with a cottony roll of white to whitish tissue........................S. sibiricus

Pileus viscid, glabrous to streaked or with fibrillose patches, yellow to dark yellow with reddish brown plaques. Tubes yellow, pores up to 2 mm broad. Stipe glandulose, dry, obscure annulus stometimes present. Spores 8-12 x 3.8-4.5 um. Cystidia clustered. Cuticle an ixotrichodermium. Western white pine.

16. Margin of pileus glabrous..........................17

17. Pileus subconic to campanulate or umbonate, 1.5-4 cm broad.........................S. helenae

Pileus viscid, virgate, ochraceous. Tubes boletinoid, yellow, pores lamellose. Stipe glandulose. No veils. Spores 6.5-9.5 x 2.8-4 um. Cystidia clustered. Cuticle a trichodermium, not appearing gelatinous. Beach pines.

17. Pileus convex to plane, 6-9 cm broad ....*S. flavogranulatus*

Pileus glabrous, viscid, pallid to pale yellow ochraceous. Context white. Tubes yellow. Stipe white then yellow, glandulose. No veils. Spores 7.5-9 x 3-3.2 um. Cystidia clavate to cylindric to fusoid, clustered. Cuticle an ixotrichodermium. Pines

18. Annulus present, existing either as a fibrillose zone or as a flared, conspicuous collar...............19

18. Annulus absent.................................22

19. Annulus represented by a thin, more or less evanescent fibrillose ring...............*S. pseudobrevipes*

Pileus dark yellow brown to cinnamon brown, viscid, glabrous, margin often appendiculate. Tubes yellow, pores 2 per mm. Stipe dry, glandulose, often obscure when young. Spores 7-9 x 2.5-3.5 um. Cystidia scattered to clustered, clavate to subcylindric. Cuticle an ixotrichodermium. Lodgepole pines.

19. Annulus and/or veil well developed................20

20. Pileus colored dark reddish brown. Annulus conspicuous, with a purple to purplish zone or outer (lower) surface......................*S. luteus*

Pileus glabrous, viscid. Tubes yellow, pores 3 per mm. Stipe glandulose above annulus. Spores 7-9 x 2.5-4 um. Cystidia clustered, clavate. Cuticle an ixotrichodermium. Conifers.

20. Pileus and annulus not with the above combination of characters....................................21

21. Pileus white when young, eventually becoming brown. Associated with sugar pines.......*S. brunnescens*

Pileus viscid, glabrous or streaked. Tubes yellow, pores 2 per mm. Stipe glandulose. No veils. Spores 6.6-8.8 x 2.8-3.2 um. Cystidia clustered, subcylindric to fusoid ventricose. Cuticle an ixotrichodermium. Sugar pines.

21. Pileus dark brown to olive brown. Pores olive gray ....*S. subolivaceus*

Pileus viscid, fibrillose to often fibrillose scaly on margin, glabrous on disc, margin glabrous. Tubes yellow, pores 1-2 per mm. Stipe with conspicuous annulus, glandulose. Spores 9-11 x 3-4 um. Cystidia clustered. Cuticle an ixotrichodermium. Conifers.

22. Pileus surface tomentose, fibrillose, fibrillose scaly or squamulose..............................23

22. Pileus glabrous, streaked or with scattered fibrils. Tomentose roll (false veil) may be present on the margin of pileus................................28

23. Context changing to blue when exposed...........24

23. Context not changing to blue when exposed but may change to some other color......................26

24. Pileus colored bright red.........S. ruber

Pileus viscid, bright red, fibrillose. Tubes yellow, pores 2 per mm. Stipe glandulose, yellow. No veils. Spores 7.8-9.8 x 2.3-4 um. Cystidia solitary or clustered. Cuticle an ixotrichodermium. No fresh material examined. Conifers.

24. Pileus yellow with grayish fibrils...............25

25. Spores up to 14 um long. Stipe fibrillose ....S. subvariegatus

Pileus dry to subviscid, squamulose. Tubes pale yellow to pale orange. Stipe pallid to yellow. Spores 9-14 x 3.5-5 um. Cystidia clustered, clavate. Cuticle an ixotrichodermium. Pines.

25. Spores up to 10 um long. Stipe glabrous, glandulose ....S. tomentosus

Pileus yellow, densely fibrillose, sometimes reddish with age, margin glabrous. Tubes yellow, pores up to 1 mm. Stipe glandulose. No veils. Spores 7-10 x 3.5-4.5 um. Cystidia clustered. Cuticle a tangled ixotrichodermium with erect fascicles of hyphae. Pines.

26. Pileus surface moist to subviscid................27

26. Pileus surface viscid............*S. acerbus*

Pileus surface fibrillose, brown to reddish brown margin glabrous. Tubes yellow, pores up to 1mm. Stipe dry, glandulose. No veils. Spores 9.3-12 x 3-3.4 um. Cystidia clustered, often rare, clavate. Cuticle an ixotrichodermium. Pines.

27. Pileus fibrils black to dark brown ....*S. fuscotomentosus*

Pileus fibrillose scaly, olive brown to fuscous, margin glabrous. Tubes yellow, up to 1 mm. Stipe glandulose, yellow, dry. No veils. Spores 9-12 x 3-4 um. Cystidia clustered, clavate. Cuticle a trichodermium with very slight gelatinization. Pines.

27. Pileus fibrils brown.............*S. californicus*

Known only by type collection. Poorly understood and description inadequate for positive determination.

28. Pileus margin appendiculate or with a distinct cottony roll at least when young........................29

28. Pileus margin glabrous at all stages.............33

29. Glandulae on stipe obscure, often apparent only at the apex. Associated with Jeffrey pines ....*S. volcanalis*

As in *S. brevipes* except for differences noted in key. Pileus often yellow. Spores 6.6-10 x 3-4 um. Jeffrey pines.

29. Glandulae apparent on stipe during all stages 30

30. Taste harsh, unpleasant. Pileus white then gray and eventually brown.................*S. pungens*

Pileus viscid, glabrous. Tubes yellow, pores 1-1.5 mm broad. Stipe glandulose. No veils. Spores 9.5-10 x 2.8-3.5 um. Cystidia clustered, clavate. Cuticle an ixotrichodermium. Monterey and knobcone pines.

30. Basidiocarps not with the above combination of characters.......................................31

31. Pileus brown to dark reddish brown; margin usually appendiculate................*S. borealis*

Pileus viscid, glabrous. Tubes yellow, pores 1 mm broad. Stipe glandulose, no annulus. Spores 6-8.5 x 3-5 um. Cystidia solitary or clustered. Cuticle an ixotrichodermium Western white pines.

31. Pileus not with the above combination of characters 32

32. Pileus white or pallid when young becoming brown to tawny with age............*S. albidipes*

Pileus viscid, glabrous. Tubes yellow, pores 3 per mm. Stipe white, obscurely glandulose, slowly darkening. No veils. Spores 6.6-8.8 x x 2.5-3 um. Cystidia clustered, clavate. Cuticle an ixotrichodermium. Pines.

32. Pileus pinkish buff to pinkish cinnamon. ....*S. glandulosipes*

Pileus viscid, glabrous. Tubes yellow, pores 1-2 per mm. Stipe dry, strongly glandulose. No veils. Spores 6-9 x 3-4 um. Cystidia clustered, clavate. Cuticle an ixotrichodermium. Beach and Bishop pines.

33. Stipe reticulate. Context changing to blue when exposed.......................*S. reticulatus*

Pileus subviscid to viscid, glabrous to obscurely appressed fibrillose, brown to reddish brown, margin glabrous. Tubes yellow, pores 1 per mm. Stipe dry. No veils, glands obscure. Spores 9-11 x 3-4 um. Cystidia clustered, clavate. Cuticle an ixotrichodermium. Pines.

33. Stipe not reticulate. Context not changing to blue when exposed......................................34

34. Pileus colored buff, brown or ochraceus at maturity 35

34. Pileus yellow at maturity......*S. wasatchicus*

Pileus viscid, glabrous, occasionally with reddish flushes. Context pale yellow. Tubes dark yellow. Stipe yellow at apex, white below, dry, glandulae conspicuous. Spores 8-10.4 x 3-4 um. Cystidia clavate to cylindric, clustered. Cuticle an ixotrichodermium. Ponderosa pines.

35. Stipe with inconspicuous glandulae or glandulae absent..36

35. Glandulae present, apparent during all stages of development....................................38

36. Pileus white at first then darkening. Spores up to 11 um in length..............*S. pallidiceps*

Pileus glabrous, eventually colored yellow to buff, viscid, margin glabrous. Tubes yellow, pores 2-3 per mm. Stipe white. No veils. Spores 8-11 x 3.5-4.2 um. Cystidia solitary to clustered, clavate. Cuticle an ixotrichodermium. Lodgepole pines.

36. Pileus and spores not as described above........37

37. Pileus buff to pinkish cinnamon ....*S. occidentalis*

Pileus viscid, glabrous, streaked. Context white then yellow. Tubes tan then yellow. Stipe dry, white to yellow, glandulae obscure or not apparent. Spores 8-9.6 x 3-4 um. Cystidia clavate, clustered. Cuticle an ixotrichodermium. Ponderosa pines.

37. Pileus dark to vinaceous or dark reddish brown. ....*S. brevipes*

Pileus viscid, glabrous or streaked, margin glabrous. Tubes yellow, pores 1-2 per mm. Stipe often very short, glandulae obscure or lacking. No veils. Spores 7-10 x 3-4 um. Cystidia clustered, clavate. Cuticle an ixotrichodermium. Pines.

38. Pileus context white, surface fibrillose to scaly ....*S. monticolus*

Pileus viscid, light brown then brown, margin glabrous. Tubes yellow, sometimes radiately arranged, pores typically up to 1 mm in diam., sometimes up to 2 mm. Stipe dry, glandulose in apex. Spores 8.5-11 x 3-4 um. Cystidia clustered, clavate. Cuticle an ixotrichodermium. Lodgepole pines.

38. Pileus not with the above combination of characters 39

39. Pileus buff to pinkish cinnamon. Pores pink to reddish (due to abundance of glandulae) ....*S. kaibabensis*

Pileus viscid, glabrous. Context white, yellow above tubes. Tubes buff then yellow. Stipe dry, white to pale yellow above, vinaceous below, glandulose. Spores 7.6-9.5 x 3.2-4.5 um. Cystidia clustered, clavate. Cuticle an ixotrichodermium. Ponderosa pines.

39. Pileus reddish brown to brown. Pores yellow ....*S. granulatus*

Pileus viscid, glabrous, white to pallid young then reddish brown to brown, margin glabrous. Tubes yellow, pores 1-2 per mm. Stipe strongly glandulose, whitish to yellow. No veils. Spores 7-9 x 2.5-3.5 um. Cystidia clustered, clavate to subcylindric. Cuticle an ixotrichodermium. Pines.

MYCOTAXON

Vol. IX, No. 1, pp. 297-340 June 12, 1979

THE ORDERS, FAMILIES, AND GENERA OF HYPOGEOUS ASCOMYCOTINA (TRUFFLES AND THEIR RELATIVES)

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SUMMARY

Of 31 genera of hypogeous Ascomycotina accepted, one is assigned to the monotypic order Elaphomycetales ord. nov. and the rest are placed in the Pezizales. The polyphyletic order Tuberales is abandoned. Nine families of the Pezizales include hypogeous species: Helvellaceae emend. nov., Pezizaceae emend. nov., Ascobolaceae, Pyronemataceae emend. nov., Balsamiaceae emend. nov., Geneaceae fam. nov., Terfeziaceae emend. nov., Tuberaceae emend. nov., and Carbomycetaceae. New genera and species are described: *Clelandia arenacea* gen. et sp. nov., *Dingleya verrucosa* gen. et sp. nov., *Choiromyces aboriginum* sp. nov., and *Peziza stuntzii* sp. nov. New combinations are proposed: *Barssia yezo-montana* (Kob.) Trappe, *Elaphomyces* subgen. *Ascoscleroderma* (Clém.) Trappe, *Genea kraspedostoma* (Gilk.) Trappe, *Labyrinthomyces varius* (Rodw.) Trappe, *Peziza ellipsospora* (Gilk.) Trappe, *Tuber hiromichii* (Imai) Trappe, *T. oligospermum* (Tul. & Tul.) Trappe, and *T. phlebodermum* (Gilk.) Trappe. A synoptic key to genera is provided.

Dr. Daniel Stuntz once emphasized to me that existing keys to the truffle genera were virtually unuseable by any but specialists and that improved, useable keys would be a real service to mycology. I can vouch that most past keys are troublesome to specialists as well. Part of the problem lies in the dearth of attention devoted to phylogenetic relationships of the hypogeous genera. Orders and families as traditionally conceived are broad, polyphyletic aggregations that include genera with similar morphologies developed by parallel or convergent evolution from disparate origins. Another source of trouble is the dichotomous key. The gross morphology of hypogeous fungi is relatively simple compared to epigeous fungi. The builder of a dichotomous key must use extraordinary care to avoid ambiguity and must often use characters that are well understood only by the specialist with considerable experience.

In this paper I propose reorganization of the genera of hypogeous Ascomycotina into groups based on phylogeny. The problems inherent in dichotomous keys are circumvented by use of a synoptic key. The paper is dedicated to Dr. Stuntz, who excited my original interest in mycology, and to Dr. Helen Gilkey, who tutored me in the hypogeous Ascomycotina for several years before her death.

PHYLOGENY

The hypogeous Ascomycotina traditionally have been treated as related to but taxonomically independent of the Pezizales. The two orders have been separated by forcible spore discharge of the former vs. no spore discharge of the latter (Burdsall 1968, Eckblad 1968, Kimbrough 1970, Korf 1973a). Trappe (1971) and Korf (1973a) suggest that evolution has proceeded from epigeous Pezizales to hypogeous Tuberales along parallel or convergent lines. Korf (1973a) presents a compelling case for the relationship and concludes: "I look with suspicion at any member of the Tuberales possessing paraphyses which do not greatly exceed in length cylindrical, 8-spored asci. How many of them are Pezizales in hiding?"

If we seek phylogenetic relationships as the foundation for taxonomy, we need not stop at relative lengths or shapes of paraphyses and asci. Burdsall (1968) began the transfer of genera of Tuberales to Pezizales with *Geopora*. An analogous process has begun with transfer of secotioid and related hypogeous Basidiomycotina from the Gasteromycetes to relevant families of Agaricales (Shaffer 1968, Smith 1973). In the taxonomic scheme presented in the following pages, I have discarded the artificial, anachronistic order Tuberales. All hypogeous genera that relate morphologically to families of Pezizales are assigned to those families. Some hypogeous families are retained with emendation but assigned to the Pezizales. The monotypic order Elaphomycetales is erected to accommodate the Elaphomycetaceae, which do not seem related to the Pezizales.

SYNOPTIC KEY

Korf's (1972) synoptic key to the Pezizales provided the means to discern relationships of genera of Tuberales to genera of Pezizales. In using it for that purpose, I became enamored with its ease and flexibility for identifying specimens in hand. With few exceptions, a hypogeous fungus can be identified by synoptic key as fast or faster than by dichotomous key. Without exception, the determination can be made with greater confidence, because all characters of the specimens can be brought into play. It is virtually impossible to identify immature specimens with a dichotomous key, but the chances are quite good with a synoptic key.

Users of the following key are advised to study Korf's (1972) lucid exposé on efficient use of synoptic keys. I merely summarize the procedure here. The key contains six major categories of characters: 1) Ascocarp morphology, 2) Peridium, 3) Asci, 4) Paraphyses, 5) Spores, and 6) Habitat. Each major category contains one or more couplets concerning individual characters. Numbers assigned to genera in the same sequence as in the ensuing generic descriptions are listed after the proper lead in each couplet. If the genus number occurs after only one lead of a couplet, it is in Roman type; if after more than one lead, in italic type.

To use the key, one can begin with any major category and couplet. To identify a specimen, the numbers recorded for the proper lead of the first couplet are jotted down on a piece of paper. Any second couplet is then selected, either from the same major category or from another. Numbers jotted on the paper from the first couplet but not listed in the proper lead of the second couplet are crossed out. The procedure is repeated with additional couplets until only one jotted number remains, representing the genus of the specimen being identified.

Korf (1972) suggests a number of refinements in the procedure to increase efficiency. Among these are clues to entering the synoptic key. To paraphrase him, a quick glance down the following list of "leading questions" should help speed identification of a hypogeous genus:

1. Does the ascocarp have an *orifice* or *distinct cavity*? If so, enter at Couplet 1-2.

2. Is the ascocarp *green, blue, violet, purple* or *black*? Enter at Couplet 1-5.

3. Does the ascocarp have a *distinct basal mycelial tuft* or *stem*? Enter at Couplet 1-6.

4. Is the interior of the ascocarp a *single chamber stuffed with spores* or is it *solid with the hymenium on the outer surface*? Enter at Couplet 1-9.

5. Do the asci become *blue in Melzer's reagent*? Enter at Couplet 3-4.

6. Are the ascus walls distinctly *brown in KOH*? Enter at Couplet 3-6.

7. Do the paraphysis *tips differentiate to form a peridium-like epithecium*? Enter at Couplet 4-2.

8. Are the *spores fusoid*? Enter at Couplet 5-1.

9. Are some *spores longer than 60 µm*? Enter at Couplet 5-2.

10. Are the *spores pitted* or *ornamented with hollow tubes*? Enter at Couplet 5-3.

11. Do the ascocarps occur in a *desert*? Enter at Couplet 6-1.

A note of caution is needed with hypogeous Ascomycotina. Maturation often takes several months, and it is quite common to find sizeable specimens that are immature. When immature, the spores of nearly all are hyaline and smooth and the full complement of spores may not be apparent in asci. Because glebal color often darkens with development of pigment in maturing spore walls, young specimens often have a much paler gleba than when mature. One of the better signals of immaturity is the absence of spores in many of the asci. If that is observed, many asci from different parts of a sporocarp or from different sporocarps in a collection should be examined to determine if some contain pigmented or ornamented spores. If one is still uncertain about mature spore color and ornamentation or number of spores per ascus, then the couplets involving these characters should be avoided in use of the synoptic key. The hazards of dealing with immature material are exemplified by *Choiromyces alveolatus* (Harkn.) Trappe, an immature collection of which served as the type species of a new genus, *Piersonia*, and other immature specimens as the respective types for four new species epithets (Trappe 1975a).

ASCOCARP MORPHOLOGY

1-1. *Shape*

a. subglobose to globose - all numbers except Roman type in b.

b. turbinate, irregular, lobed, cerebriform, etc. *2*, *3*, *5*, 6, *7*, 9, *10*, *12*, *14*, *15*, *16*, *19*, *20*, *21*, *22*, 23, *24*, *25*, *26*, *27*, *28*, *29*, *30*

1-2. *Orifice or cavity to interior*

a. absent - all numbers except Roman type in b.

b. present *2*, 5, 13, 17, *19*, *20*, 22, 23, *29*

1-3. *Largest dimension*

a. <1 cm *2*, 11, *13*, *16*, *17*, *18*, *20*, *22*, *23*, *25*, *26*, *29*, 30

b. 1-4 cm *1*, *2*, *3*, 4, *5*, *6*, 7, 8, 9, *10*, *12*, *13*, *14*, 15, *16*, *17*, *18*, 19, *20*, 21, *22*, *23*, *24*, *25*, *26*, *27*, 28, *29*, 31

c. >4 cm *1*, *2*, *5*, *6*, *10*, *12*, *14*, *21*, *24*, *25*, *27*, *29*

1-4. *Surface configuration*

a. smooth (even) *1,* 2, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, *21,* 24, *25,* 26, 27, 28, *29,* 30, 31

b. with rounded warts *1, 9, 20, 21, 22,* 23, *25, 29*

c. with angular warts *1,* 3, *9, 20, 21, 22, 25, 29*

1-5. *Surface color*

a. absent (white) *5, 6, 8, 15, 17, 26, 28, 29, 31*

b. yellow (various tones) *2, 8, 10, 18, 23, 24, 25, 26, 27, 28, 29, 30, 31*

c. green or blue *1, 25*

d. orange, pink, or red *2, 9,* 16, *19, 20, 25, 29*

e. brown (various tones) *1, 2,* 3, 4, *5,* 7, *9, 10, 11,* 12, 13, 14, *15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 29,* 30, *31*

f. violet or purple *6, 11*

g. black *1, 2, 9, 20, 21, 22, 23, 25, 27, 29*

1-6. *Basal mycelial tuft or stem*

a. absent - all numbers except Roman type in b.

b. present *1, 4,* 5, *11,* 12, 17, 18, *20,* 22

1-7. *Surface texture*

a. glabrous *1, 2, 3, 5, 6,* 7, *8, 10,* 11, *14, 15,* 16, *17,* 18, *19,* 20, *21, 22,* 23, *24,* 25, *26,* 27, 28, *29,* 30, 31

b. scabrous *1, 2,* 4, *5, 6, 8, 17, 19, 21, 24, 26, 29*

c. pubescent or tomentose *1, 3,* 9, 12, 13, *14, 15, 21, 22,* 28, *29*

1-8. *Color of spore-bearing tissues at maturity (all are pale when immature)*

a. absent (white to pale gray) *5, 6, 7, 10,* 12, 13, 14, 15, 17, 19, *20,* 22, *23, 26*

b. yellow (various tones) *1, 2, 7,* 8, *10,* 16, *18, 20,* 21, *23, 24, 25, 26, 27*

c. pink to red *9, 28*

d. brown to olive (various tones) *1, 2, 3,* 4, *5, 9, 11, 18, 21, 24, 25, 26, 27, 28, 29,* 30, 31

e. violet to purple *2, 5, 6, 11*

f. black *1, 2, 25, 29*

1-9. *Glebal structure*

a. single, empty chamber *1, 2,* 5, *6,* 13, *16,* 17, 22, *23*

b. single chamber stuffed with spores or hyphae *1, 16*

c. multiple, empty chambers or open veins *2, 6,* 7, 12, *14,* 15, 19, *20, 23*

d. multiple chambers or veins loosely stuffed with hyphae *14, 20*

e. solid with rounded to labyrinthiform pockets separated by walls of paler tissue 3, *8, 9,* 10, 21, *24,* 27, 28, 31

f. solid with narrow, pale meandering veins 4, *6, 8, 9, 24,* 25, 26, 29, 30

g. solid with hymenium on outer surface 11, 18

1-10. *Columella*

a. absent - all numbers except 4

b. present 4

PERIDIUM

2-1. *Presence*

a. absent 11, 18, *28*

b. present - all numbers except 11 and 18

2-2. *Epicutis*

a. interwoven to parallel hyphae *1, 6,* 7, 10, *15, 19, 24, 29,* 30, *31*

b. interwoven hyphae mixed with ± isodiametric cells 4, *6, 8, 15, 19, 24,* 27, *28, 29, 31*

c. ± isodiametric cells only *1,* 2, 3, 5, *6, 8,* 9, 12, 13, 14, *15,* 16, 17, 20, 21, 22, 23, 25, 26, *28, 29*

ASCI

3-1. *Shape*

a. cylindric to clavate *2,* 3, 5, 6, *7, 8,* 11, 12, 13, 14, *15, 16,* 17, 18, 19, *20,* 22, *23, 24, 25, 28*

b. saccate to ellipsoid or obovoid *2,* 4, *7, 8, 9,* 10, *15, 16, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30*

c. subglobose to globose 1, *9, 21, 25, 26, 27, 29, 30,* 31

3-2. *Number of spores per ascus at maturity* (young specimens often show fewer spores per ascus than at maturity)

a. 1 only 30

b. 1-6 *4, 14, 15,* 16, *23,* 28, 29

c. 4-8 *4,* 9, *12, 14, 15, 23, 24, 25, 26,* 27

d. 8 only 1, 2, 3, 5, 6, 7, 8, 10, 11, *12*, 13, 17, 18, 19, 20, 21, 22, *24*, *25*, *26*, 31

3-3. *Spore arrangement in asci*

a. uniseriate only *2*, 3, 5, 6, 11, 12, 13, 14, 15, 16, 17, 18, *19*, 22, *23*, *24*, *25*, *28*

b. at least some biseriate *2*, *4*, 7, 8, *19*, *23*, *24*, *25*, *28*

c. irregularly clustered 1, *2*, *4*, 9, 10, 20, 21, *23*, *24*, *25*, 26, 27, 29, 31

3-4. *Iodine reaction in Melzer's reagent*

a. yellow to orange - all numbers except Roman type in b and c

b. blue only near ascus apex 5, 6, *7*

c. diffusely green or blue over most of ascus *7*, 8, 9, 10, 11, *25*

3-5. *Ascus arrangement*

a. mostly in a hymenial palisade 2, 3, 5, 6, 7, 8, 11, 12, 13, 14, 15, *16*, 17, 18, 19, 22, 23, 24, *25*

b. mostly randomly embedded in glebal tissue 4, 9, 10, 20, 21, *25*, 26, 27, 28, 29, 30, 31

c. borne among loose hyphae 1, *16*

3-6. *Color in KOH*

a. hyaline - all numbers except 31

b. brown *2*, *4*, 31

PARAPHYSES

4-1. *Presence*

a. paraphyses present - all numbers except Roman type in b.

b. paraphyses absent 1, 4, 9, 10, 16, 21, *25*, 26, 27, 28, *29*, 30, 31

4-2. *Tip differentiation*

a. tips free, rounded 2, 3, 5, 6, 7, *8*, 11, 12, *14*, 15, *16*, 19, *24*, *25*

b. at least some paraphyses growing beyond the palisade to stuff glebal veins or chambers *8*, *14*, *16*, *24*, *25*, 29

c. tips differentiated to form a peridium-like epithecium that encloses the hymenium 13, 17, 22, 23

SPORES

5-1. *Shape*

a. cylindric to ellipsoid *2*, 3, 4, 5, 6, 8, *10*, *12*, *14*, 17, *19*, 20, *21*, *22*, *23*, 24, *29*, *30*, *31*

b. fusoid *21*

c. subglobose *2*, *7*, *10*, *12*, *21*, *22*, *29*, *30*

d. globose 1, *2*, *7*, 9, *10*, 11, 13, *14*, 15, 16, 18, *19*, *21*, *22*, *23*, 25, 26, 27, 28, *29*, *30*, *31*

5-2. *Length (or diameter if globose) excluding ornamentation*

a. < 20 µm *1*, *2*, *3*, 5, 6, 7, *8*, *9*, *10*, *15*, *16*, *18*, *20*, 25, *26*, *27*, 31

b. 20-40 µm *1*, *2*, *3*, *8*, *9*, *10*, 11, 12, 13, 14, *15*, *16*, 17, *18*, 19, *20*, *21*, *22*, *23*, 24, *26*, *27*, 28, *29*

c. 40-60 µm *1*, *2*, *4*, *15*, *20*, *21*, *22*, 23, *27*, *29*

d. >60 µm *4*, *21*, *29*, 30

5-3. *Ornamentation at maturity (spores of all species are smooth in youth)*

- a. smooth 5, *6*, 7, *10*, 12, 13, 14, 16, 17, 19, *20*, 21, *31*
- b. minute lines or roughening *10*, *20*
- c. warts *1*, *2*, *3*, *4*, *6*, *8*, *9*, 15, 22, *24*, *25*, *27*
- d. amorphous epispore *1*, *2*, *3*, *8*
- e. pits *2*, *8*, *24*
- f. spines or rods *1*, *2*, *4*, *9*, *11*, *18*, 23, *24*, *25*, *27*, *28*, *29*, *31*
- g. hollow tubes *24*
- h. reticulation *1*, *2*, *6*, *11*, *18*, 26, *27*, *28*, *29*, 30

5-4. *Color at maturity (spores of all species are hyaline in youth)*

- a. hyaline 5, *6*, 7, *8*, *9*, 10, 11, 12, 13, 14, *15*, 16, 17, *18*, 19, 20, *21*, 22, *24*, *25*, *26*, *31*
- b. yellow to pale brown *1*, *2*, *6*, *8*, *9*, *15*, *18*, *21*, *23*, *24*, *25*, 26, *27*, *29*, *31*
- c. medium brown *1*, *2*, 3, *4*, *18*, *21*, *23*, *25*, *29*, *30*
- d. dark brown to nearly opaque *1*, *4*, *29*, *30*

HABITAT

6-1. *Plant associations*

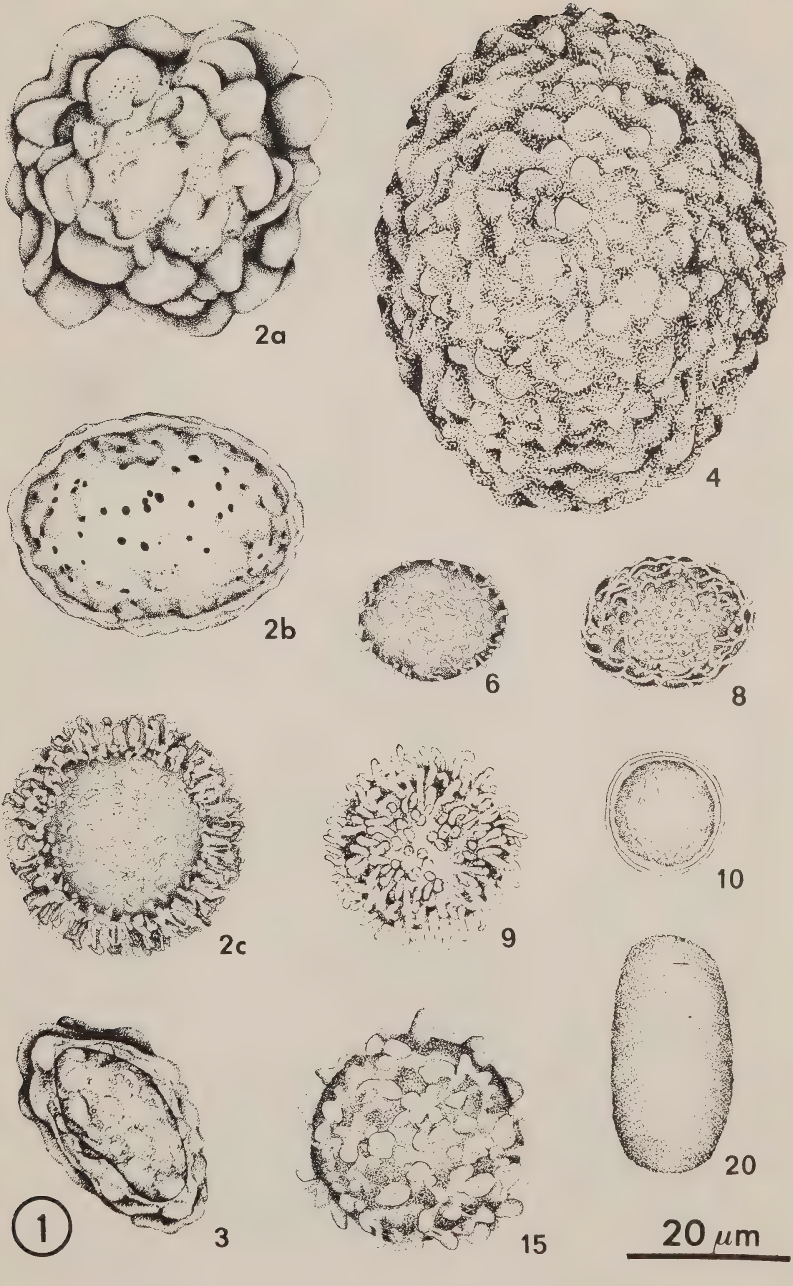
- a. temperate to boreal - all except Roman type in b and d
- b. tropical *1*, 17, *23*, *29*
- c. subalpine to subarctic *1*, *2*, *12*, *29*
- d. desert *5*, 7, 10, *14*, *21*, *24*, *27*, 31

PLATES 1-3. Spores of representative species of genera of hypogeous Ascomycetes (numbered as in the text descriptions).

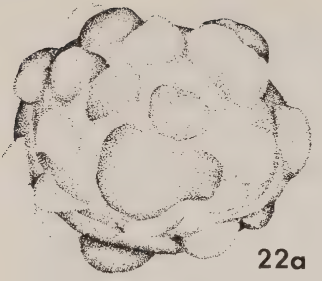
1--(2) *Hydnotrya* spp.: (2a) *H. tulasnei*, (2b) *H. variiformis*, (2c) *H. cerebriformis*. (3) *Dingleya verrucosa*. (4) *Fischerula macrospora*. (6) *Peziza ellipsospora*. (8) *Hydnotryopsis compacta*. (9) *Amylascus herbertianus*. (10) *Tirmania pinoyi*. (15) *Labyrinthomyces varius*. (20) *Balsamia alba*.

2--(22) *Genea* spp.: (22a) *G. gardneri*, (22b) *G. compacta*, (22c) *G. arenaria*. (23) *Genabea fragilis*. (24) *Choiromyces* spp.: (24a) *C. echinulatus*, (24b) *C. alveolatus*, (24c) *C. venosus*. (25) *Pachyphloeus* spp.: (25a) *P. conglomeratus*, (25b) *P. citrinus*. (26) *Hydnobolites cerebriformis*. (27) *Terfezia* spp.: (27a) *T. arenaria*, (27b) *T. claveryi*, (27c) *T. longii*.

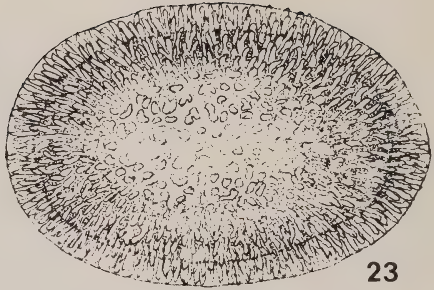
3--(29) *Tuber* spp.: (29a) *T. brumale*, (29b) *T. besseyi*, (29c) *T. aestivum* var. *mesentericum*, (29d) *T. shearii*. (30) *Paradoxa monospora*. (31) *Carbomyces* spp.: (31a) *C. longii*, (31b) *C. emergens*.



2a
2b
2c
20 µm



22a



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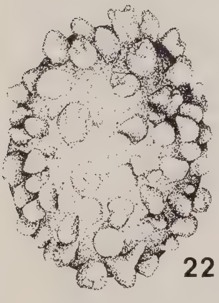

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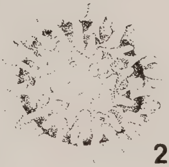

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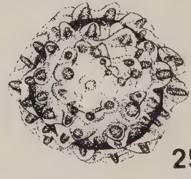

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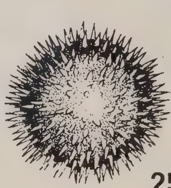

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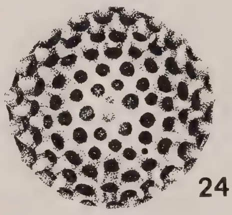

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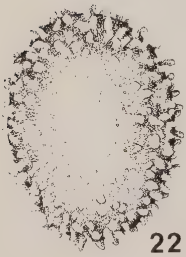
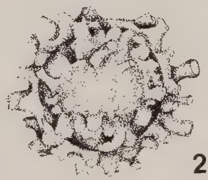


22c



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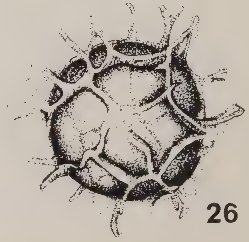

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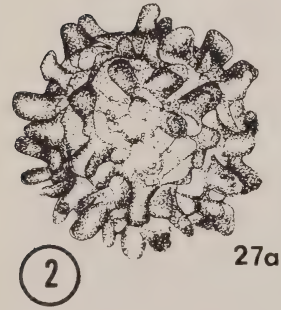

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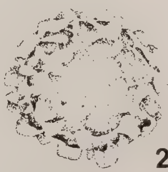

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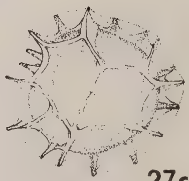
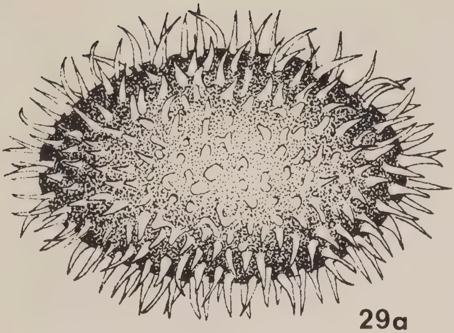


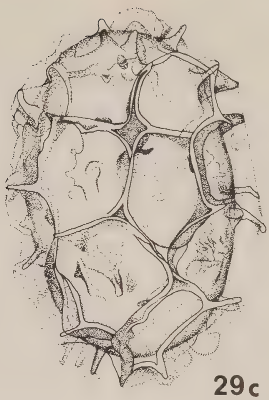
27c

②

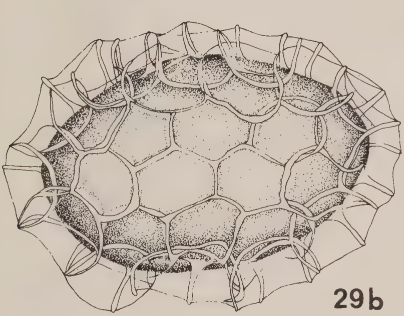
20 μm



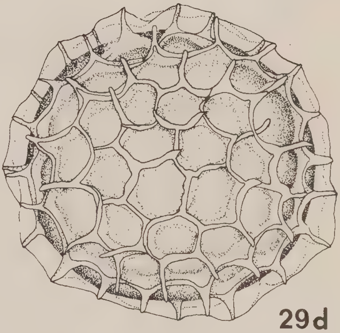
29a



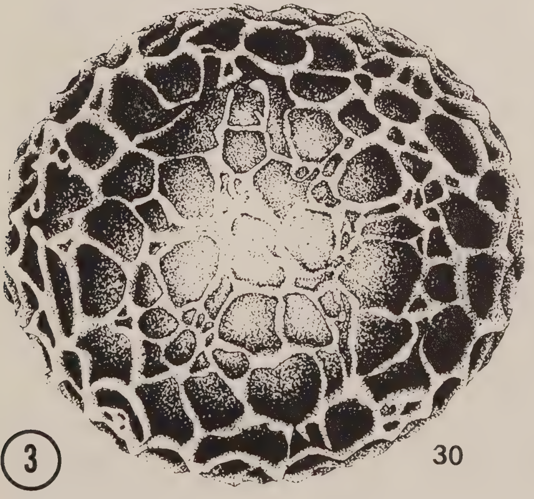
29c



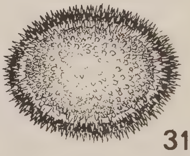
29b



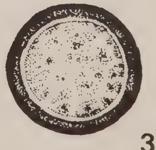
29d



30



31a



31b

③

20 μm

Order ELAPHOMYCETALES ord. nov.

Cleistothecia composed of a thick peridium enclosing a single chamber. Ascogenous hyphae emerge from the chamber lining to loosely stuff the chamber. *Asci* globose, mostly with 8 clustered spores, evanescent. *Spores* globose, ornamented, at maturity filling the ascocarp chamber as a powdery mass. DISCUSSION: The monotypic family Elaphomycetaceae has been the spurned stepchild of the hypogeous Ascomycotina, often placed in the Tuberales because it is hypogeous and not satisfyingly related to other orders (Fennell 1973, Korf 1973b). Because its relationships to the Tuberales or Pezizales are equally unsatisfying, it deserves erection of a new order.

Family ELAPHOMYCETACEAE Tulasne & Tulasne 1851

1. *Elaphomyces* Nees ex Fries 1829, lectotype *E. granulatus* Fries. SYNONYMS: See Dodge 1929.

Ascocarps subglobose, 1-3 (-4) cm in diam, the surface brown to dark blue or black, smooth or ornamented with hard, rounded warts, pyramids, or cones, often tomentose and enhusked by proliferated ectomycorrhizae of associated trees or shrubs. *Peridium* mostly 2-5 mm thick, crisp-fleshy to leathery or carbonaceous. *Gleba* a single chamber hollow in youth but soon loosely stuffed with ascogenous hyphae and finally packed with brownish yellow to black spore powder. *Asci* globose, with 8 clustered spores, nonamyloid, evanescent before spores are morphologically mature. *Spores* globose, 8-30 (-45) µm in diam excluding ornamentation of spines, reticulum, or spiralled ridges, in most species olive to brown or nearly opaque by maturity. SPECIES: ± 30 known, with a roughly equal number of additional species epithets as synonyms. Cosmopolitan in association with ectomycorrhizal hosts. Species such as *E. granulatus* Fr. and *E. muricatus* Fr. are among the more common hypogeous fungi in boreal, subalpine, and subarctic forests of the northern hemisphere. KEY: Dodge (1929) includes the common species but is recommended only because nothing better is available. DISCUSSION: Clémencet (1932) erected the genus *Ascoscleroderma* to accommodate *E. cyanosporus* Tul. & Tul., because it is "substipitate." It has an often ephemeral, basal mycelial tuft but is not truly substipitate. This feature hardly justifies a new genus and may, indeed, be subtly present in other *Elaphomyces* species. Because it may be a useful character for infrageneric separation, however, I reduce the rank of *Ascoscleroderma* to subgenus. Mature hypogeous specimens in the Basidiomycete genus *Scleroderma* can be mistaken for *Elaphomyces* spp. In both cases the powdery spore mass leaves little evidence of spore origins by maturity, and the spores are similar in appearance. Sporocarps of most *Scleroderma* spp., however, have a distinct basal attachment whereas this is obscure or lacking in *Elaphomyces*. Sterigmal attachments are generally evident on *Scleroderma* spores. *Scleroderma* spp. are never blue or black, never enhusked by proliferated mycorrhizae, and never have hard, rounded warts, pyramids, or cones on the sporocarp surface.

Order PEZIZALES sensu Korf 1973b emend. nov.

The order is emended to include hypogeous taxa with cylindric to globose asci sometimes embedded in tramal tissues rather than borne in a distinct hymenium and lacking forcible spore discharge. DISCUSSION: Korf (1973a) believes "the Tuberales to represent a biological unit rather than a phylogenetic one. Several distinct lines of the Pezizales have presumably given rise to members of the Tuberales, independently by loss of functional opercula." For phylogenetic integrity, the hypogeous taxa need to be transferred to appropriate families of Pezizales whenever the evidence so indicates. Families and genera of Tuberales that cannot be linked to those of epigeous Pezizales are retained as discreet entities within the Pezizales. The order Tuberales is abandoned.

Family HELVELLACEAE Dumortier 1829 sensu Korf 1972 emend. nov.

The family is emended to include astipitate, infolded and chambered to solid, hypogeous sporocarps with cylindric to globose asci sometimes embedded in tramal tissue and lacking forcible spore discharge. DISCUSSION: Korf (1973a) in effect emended the family to include astipitate, infolded and chambered ascocarps by the description of *Helvella astieri* Korf and Donadini. This species is essentially a *Hydnotrya* with operculate asci and hyaline spores. Transfer to the Helvellaceae of *Hydnotrya* and related genera evolved to spore dispersal by animal mycophagy is clearly in keeping with phylogenetic relationships.

2. *Hydnotrya* Berkeley & Broome 1846, monotype *H. tulasnei* (Berk.) Berk. & Broome. SYNONYMS: see Trappe 1975a. PLATE 1.

Ascocarps urnulate to cerebriform, 0.5-6 (-8) cm in diam, the surface pale yellow to yellowish pink, reddish brown, brown, or nearly black, smooth or minutely scurfy. *Peridium* composed of rounded to subangular, inflated cells often arranged in chains with clavate terminal cells. *Gleba* sometimes a single, empty, hymenium-lined chamber (small specimens) but usually with a few to many small to large chambers formed by complex infolding and fusing of sporocarp walls; trama concolorous with sporocarp surface; hymenia white in youth but reddish brown to brown at maturity. *Asci* cylindric to clavate or saccate, with 8 uniseriate to biseriate spores, nonamyloid, indehiscent, formed among paraphyses in a hymenial palisade (in a few species some asci also embedded in tramal tissue). *Spores* ellipsoid to globose, 16-34 x 16-35 µm excluding ornamentation, smooth in youth but soon with a yellow to brown, amorphous, cyanophilic epispore that is smooth, pitted, warty, or ridged. A few globose-spored species have echinulate spores. SPECIES: ± 12, with a roughly similar number of additional species epithets as synonyms. North America and Europe in ectomycorrhizal forests. The genus has not been reported yet from Asia but surely occurs there. KEY: Gilkey's (1954) key is the most complete available. In that key, *H. ellipsospora* Gilkey is a sparassoid *Peziza* and is thus recombined at the end of this paper, and *H. yukonensis* Gilkey is a synonym of *H. michaelis* (Fischer) Trappe. DISCUSSION: The echinulate, globose-spored species of *Hydnotrya* are structurally similar to the other species of the genus. Because of their spore characters, however, they do not conform completely to the Helvellaceae. If future studies reveal a different affinity, they may deserve generic separation.

3. *Dingleya* gen. nov., monotype *D. verrucosa* sp. nov. PLATES 1 and 4.

Ascocarps subglobose to irregular, 1-3.5 cm in diam, the surface verrucose with polyhedral warts, glabrous but with small, tomentose patches scattered among the warts. *Peridium* of inflated, ± isodiametric cells. *Gleba* solid, of pallid tramal tissue with narrow, labyrinthiform chambers lined with hymenial palisades and stuffed with asci and spores. *Asci* cylindric, with 8 uniseriate spores, nonamyloid, indehiscent, hyaline, formed among scattered paraphyses in a loose hymenium. *Spores* ellipsoid, 19-26 x 15-18 µm excluding ornamentation, smooth in youth but soon developing a brown, amorphous, cyanophilic, knobbed and ridged epispore. SPECIES: 1, New Zealand. DISCUSSION: *Dingleya* resembles *Hydnotrya* except for the solid gleba and verrucose surface. The former character seems likely to be an evolutionary advance towards spore dispersal by mycophagy. The latter may simply result from continued expansion of the gleba after the helvelloid epicutis of isodiametric cells has completed its development.

4. *Fischerula* Mattirolo 1928, monotype *F. macrospora* Matt. PLATE 1.

Ascocarps subglobose, astipitate to substipitate, 0.8-2.5 cm in diam, the surface yellowish pink to yellowish brown or dark brown, scabrous. *Peridium* of hyphae and inflated cells 5-30 (-40) µm in diam. *Gleba* solid, at maturity brown to dark brown, marbled with white to grayish yellow veins that emerge through the peridium; columella present or absent. *Asci* ellipsoid to obovoid, reniform, or clavate, with 1-6 (-8) uniseriate to clustered spores, nonamyloid, indehiscent, with 1-3 or more wall layers, randomly embedded in glebal tissue. *Spores* ellipsoid, 40-77 (-101) x 25-59 µm excluding ornamentation, smooth in youth, at maturity ornamented with conic warts, broad ridges, or agglutinated flexuous spines, dark brown. SPECIES: 2, Italy, Oregon and Washington. KEY: Trappe (1975b). DISCUSSION: *Fischerula* has distinct ties to *Hydnotrya* and thus to the Helvellaceae. It is analogous to the genus *Tuber* in having evolved to a morphology completely adapted to spore dispersal by mycophagy, with asci embedded in tissue. The strongly developed epispore may have particular functions related to the passage of spores through an animal digestive tract.

Family PEZIZACEAE Fries 1822 sensu Korf 1972 emend. nov.

The family is emended to include chambered or solid hypogeous taxa with cylindric to globose asci sometimes embedded in tramal tissue and lacking forcible spore discharge.

5. *Sarcosphaera* Auerswald 1869, monotype *S. macrocalyx* (Reiss) Auersw. [=*S. crassa* (Santi ex Stendel) Pouzar.] SYNONYMS: *Caulocarpa* Gilkey 1947.

Ascocarps when hypogeous subglobose, 2-6 cm in diam, sordid white to brown, glabrous to minutely scabrous, the upper surface furrowed and sometimes split open, short-stipitate. *Peridium* of inflated, irregular cells. *Gleba* a hollow chamber or occasionally 2-4 chambers formed by infolding of ascocarp walls, white to gray in youth becoming deep dingy violet by maturity. *Asci* cylindric, with 8 uniseriate spores, amyloid near the apex, operculate, formed among paraphyses in a hymenial palisade. *Spores* ellipsoid, 10-18 x 6-8 µm, smooth, hyaline. SPECIES: Apparently 1. Hypogeous fruiting of this normally epigeous Discomycete has been observed only under thick, felted humus in subalpine zones of western North America. DISCUSSION: Trappe (1975a) relates the taxonomic confusion resulting from the hypogeous fruiting of this fungus.

6. *Peziza* Linnaeus per St.-Amans 1821, lectotype *P. vesiculosa* Bull. per St.-Amans. SYNONYMS: see Korf (1973a) and Trappe (1975a) for hypogeous taxa. PLATES 1 and 4.

Hypogeous *ascocarps* 2-6 (-12) cm in diam, urnulate to turbinate or cerebriform, white to pink or violet, glabrous to scabrous. *Gleba* nearly solid with veins or with chambers lined with hymenia. *Asci* cylindric, with 8 uniseriate spores, amyloid near the apex, operculate, formed among paraphyses in a hymenial palisade. *Spores* cylindric to ellipsoid or globose, 8-18 x 4-14 µm excluding ornamentation, smooth to verrucose or reticulate, hyaline to light brown. SPECIES: 6 hypogeous species, including *P. stuntzii* sp. nov. and *P. ellipsospora* (Gilkey) comb. nov. North America, Europe and Australia. KEY: Korf (1973a) includes species recognized to that time. In his key *P. jactata* Burds. & Korf in Burds. =*P. whitei* (Gilkey) Trappe (1975a). DISCUSSION: Korf (1973a) discusses the sparassoid species, some of which are hypogeous to subhypogeous, in relation to the genus as a whole.

7. *Clelandia* gen. nov., monotype *C. arenacea* sp. nov.

Ascocarps ± 2 cm in diam, deeply furrowed, glabrous. *Peridium* of interwoven hyphae. *Gleba* with empty, labyrinthiform chambers lined with hymenia. *Asci* cylindric to saccate, with 8 uniseriate to biseriate spores, diffusely amyloid with the reaction strongest near the apex, indehiscent, formed among somewhat shorter, scattered paraphyses in hymenial palisades. *Spores* broadly ellipsoid to subglobose, 10-12 x 8-10 µm, smooth, hyaline, mostly containing a deBary bubble. SPECIES: 1, Australia. DISCUSSION: *Clelandia* resembles *Peziza* sensu lato in several anatomical features, but its cleistothecial sporocarp and indehiscent asci justify its separation at the generic level.

8. *Hydnotryopsis* Gilkey 1916, monotype *H. setchellii* Gilk. PLATE 1.

Ascocarp subglobose to irregular, 1-3 cm in diam, white to sordid yellow, glabrous to minutely scabrous. *Peridium* of ± isodiametric cells, sometimes with intermingling hyphae. *Gleba* solid, with labyrinthiform chambers or meandering veins lined by hymenia and stuffed with asci, spores, and mycelium, grayish yellow to brownish yellow. *Asci* cylindric to clavate or saccate, with 8 uniseriate to biseriate or clustered spores, diffusely amyloid, indehiscent, formed among paraphyses in hymenial palisades. *Spores* ellipsoid, 11-22 x 10-18 µm excluding ornamentation, smooth in youth but soon developing an amorphous, papillose to foveolate epispore, brownish yellow. SPECIES: 2, California. KEY: Gilkey 1954 (as *Choiromyces*). DISCUSSION: In its evolution to a solid gleba, *Hydnotryopsis* is related to *Peziza* a step farther away than *Clelandia*. The species are discussed by Trappe (1975a). Fischer (1938) placed this genus in the Pezizaceae.

9. *Amylascus* Trappe 1971, holotype *A. herbertianus* (Cribb) Trappe. PLATE 1.

Ascocarps turbinate to plicate or lobed, 1-3 cm in diam, red to brown or blackish brown, verrucose, tomentose. *Peridium* with ± isodiametric cells. *Gleba* with meandering veins or labyrinthiform chambers lined with a peridium-like epithecium of ± isodiametric cells. *Asci* ellipsoid to obovoid or subglobose, with (3-) 5-8 clustered spores, diffusely amyloid, indehiscent, embedded in tramal tissue. *Spores* globose, 15-24 µm diam excluding ornamentation, smooth in youth but soon developing spines or mucilage-embedded rods and cones, hyaline to pale yellowish brown. SPECIES: 2, Australia. KEY: Trappe 1975c. DISCUSSION: *Amylascus* has considerable anatomical ties to *Peziza* sensu lato. It is a step farther removed from traditional Discomycetes than *Hydnotryopsis* in having lost the hymenial palisade.

10. *Tirmania* Chatin 1890, monotype *T. africana* Chatin [=*Tirmania nivea* (Desf. ex Fries) Trappe]. PLATE 1.

Ascocarps subglobose to turbinate or lobed, up to 14 cm in diam, glabrous, wrinkled or cracked, with a basal mycelial attachment, yellow to brown or reddish brown. *Peridium* with large hyphae and many inflated cells. *Gleba* solid, of white to light yellow or ochraceous fertile pockets separated by white, sterile but otherwise undifferentiated tramal veins. *Asci* ellipsoid to obovoid, with 8 clustered spores, diffusely amyloid (sometimes weakly), indehiscent, randomly embedded in tissue of fertile pockets. *Spores* broadly ellipsoid to globose, 16-23 x 13-19 µm, smooth or, if roughened, the ornamentation enclosed by a smooth epispore, hyaline. SPECIES: 2, West Asia and North Africa. KEY: Malençon (1973) describes both species. DISCUSSION: This genus has been assigned to the Terfeziaceae sensu lato (Trappe 1971). Macroscopically it seems far removed from the Discomycetes, but its anatomy relates much more closely to the Pezizaceae than to any genera of the Terfeziaceae *sensu stricto*.

Family ASCOBOLACEAE Boudier ex Saccardo emend. Korf 1972

11. *Sphaerosoma* Klotzsch in Dietrich 1839 sensu Korf 1972, monotype *S. fuscescens* Klotzsch in Dietr.

Ascocarps pulvinate to globose, 0.5-1.5 cm in diam, brown to purple, glabrous. *Peridium* lacking. *Asci* cylindric to clavate, with 8 uniseriate spores, diffusely amyloid, operculate, formed among paraphyses in a hymenial palisade covering the sporocarp surface. *Spores* globose, 20-30 µm in diam, echinulate or reticulate, hyaline. SPECIES: 3, North America and Europe. KEY: No satisfactory keys exist. DISCUSSION: The placement of this genus follows Korf (1972). I have not examined specimens.

Family PYRONEMATACEAE Corda 1842 sensu Korf 1972 emend. nov.

The family is emended to include chambered or solid hypogeous sporocarps with cylindric to globose asci sometimes embedded in tramal tissue and lacking forcible spore discharge.

12. *Geopora* Harkness 1885, monotype *G. cooperi* Harkn. SYNONYMS: see Burdsall 1968.

Ascocarps subglobose to globose, 1-7 (-10) cm in diam, cupulate to convoluted, brown, tomentose. *Peridium* of ± isodiametric cells. *Gleba* a hollow chamber or many-chambered from infolding of sporocarp walls, chambers lined with hymenia, white to gray. *Asci* cylindric, with (6-)-8 uniseriate spores, nonamyloid, operculate, formed among paraphyses in hymenial palisades. *Spores* ellipsoid to subglobose, 20-30 x 13-24 µm, smooth, hyaline. SPECIES: 12, Northern Hemisphere. KEY: Burdsall (1968). DISCUSSION: The disposition of *Geopora* is fully discussed by Burdsall (1968) and Korf (1972), who places it in subfamily Otideoideae, tribe Mycolachneae. Fischer (1938) had earlier assigned it to the Pezizaceae sensu lato.

13. *Hydnocystis* Tulasne & Tulasne 1845a, monotype *H. piligera* Tul. & Tul. SYNONYMS: see Trappe 1975a.

Ascocarps globose, 0.4-2 cm in diam, often substipitate, with a single opening from the interior, brown, tomentose. *Peridium* of subangular, ± isodiametric cells. *Gleba* a hollow chamber lined with an epithecium of interwoven hyphae. *Asci* cylindric to subclavate with 8 uniseriate spores, nonamyloid, indehiscent, formed in a hymenial palisade among paraphyses that extend to produce the epithecium (a few asci also embedded in the subhymenium). *Spores* globose, 24-35 µm in diam, smooth, hyaline. SPECIES: 2, Europe and Japan. KEY: Burdsall (1968) describes the type species and Kobayasi (1963) describes *H. japonica* (Kob.) Trappe. DISCUSSION: Fischer (1938) assigned *Hydnocystis* to the Pezizaceae sensu lato and Burdsall (1968) to the Geneaceae because of its epithecium-enclosed hymenium and indehiscent asci. In other respects, however, it little resembles Geneaceae sensu stricto. Its apparent relationship to the genus *Trichophaea* sensu Korf (1972) suggests placement in tribe Mycolachneae.

14. *Stephensia* Tulasne & Tulasne 1845b, monotype *S. bombycina* (Vittadini) Tul. & Tul. SYNONYMS: *Densocarpa* Gilkey 1954, *Elderia* McLennan 1961.

Ascocarps globose to irregular, 1-4(-7) cm in diam, light pinkish brown to brown, pubescent to tomentose (in one species the tomentum is evanescent on the upper ascocarp surface). *Peridium* of subangular to globose cells. *Gleba* pallid, infolded or with chambers lined with hymenia and loosely stuffed with cottony hyphae or asci and spores, by maturity the larger chambers often partly empty. *Asci* cylindric to narrowly clavate, with 1-8 uniseriate spores, nonamyloid, indehiscent, formed in a hymenial palisade among paraphyses that extend to stuff the chambers, a few asci often embedded in tramal tissue. *Spores* ellipsoid to subglobose or globose, 12-26 µm in diam if globose, 28-40 x 15-18 µm if ellipsoid, smooth, hyaline. SPECIES: 6, North America, Europe, West Asia, Indonesia, and Australia. KEY: Fischer (1938) is inadequate but the best available. DISCUSSION: *Stephensia* appears derived from genera in the tribe Mycolachneae emend. Korf (1972). McLennan's (1961) erection of the monotypic genus *Elderia* with *Stephensia arenivaga* Cooke & Massee as type species was based on a new collection presumed to be that species. It is actually a quite different taxon, described later in this paper as *Choiromyces aboriginum* sp. nov. The type collection of *S. arenivaga* satisfactorily conforms to the original concept of *Stephensia*.

15. *Labyrinthomyces* Boedijn 1939, monotype *L. steenisii* Boed. [=*L. varius* (Rodway) comb. nov.]. PLATE 1.

Ascocarps globose to subglobose or lobed, 1-4 cm in diam, the surface white to brown, glabrous to tomentose or areolate. *Peridium* of interwoven hyphae, ± isodiametric cells, or a mixture of the two. *Gleba* with labyrinthiform, open to appressed chambers lined with hymenia and often filled with asci and spores at maturity. *Asci* cylindric to clavate or ventricose, with 2-8 uniseriate spores, nonamyloid, indehiscent, formed among shorter to equal paraphyses in a hymenial palisade. *Spores* globose, 18-47 µm in diam excluding ornamentation, smooth in youth but soon developing scattered to crowded, hemispherical warts, hyaline to light brown. SPECIES: 4, Australia, Indonesia, and North Africa. KEY: Beaton and Weste (1977).

DISCUSSION: The type of *Labyrinthomyces* seems well related to tribe Mycolachneae. At least one species, *L. donkii* Malençon, diverges sufficiently from the type concept in peridial and spore characteristics that it may deserve assignment to another genus. An examination of the type collection of *Stephensia varia* Rodway revealed it to be synonymous with *L. steenisii*. The Rodway epithet having priority, it is recombined as *L. varius*.

16. *Paurocotylis* Berkeley in Hooker 1855, monotype *P. pila* Berk. in Hook.

Ascocarps subglobose to flattened or irregular, 0.5-3 cm in diam, glabrous, orange-red to scarlet. *Peridium* of ± isodiametric cells. *Gleba* of one or a few chambers divided by loosely formed, irregular walls, empty except for ingrowing mycelial tufts and protrusions, lined with tangled asci, pale yellow to pale brownish yellow. *Asci* of various shapes, with 2-6 uniseriate to irregularly arranged spores, nonamyloid, indehiscent and collapsing, loosely arranged in a quasi-hymenium that lacks paraphyses. *Spores* globose, 17-23 µm in diam, smooth, hyaline. SPECIES: 1, New Zealand and England. DISCUSSION: This colorful species is described in detail by Dennis (1974). It suggests an aleurioid fungus gone underground and fits nicely in tribe Aleurieae sensu Korf (1972).

17. *Petchiomyces* Fischer & Mattirolo in Fischer 1938, monotype *P. thwaitesii* (Berk. & Broome) Fisch. & Matt. in Fisch.

Ascocarps urnulate, 0.5-3 cm in diam, white to brown, glabrous to scabrous. *Peridium* of isodiametric cells that cover both the outer surface and hymenium. *Gleba* a hymenial palisade with the paraphysis tips differentiated to form a peridium-like epithecium. *Asci* cylindric to clavate, with 8 uniseriate spores, nonamyloid, indehiscent, formed among paraphyses in a hymenial palisade enclosed by the epithecium. *Spores* ellipsoid, 24-37 x 14-17 µm, smooth, hyaline. SPECIES: 2, Indonesia and Sri Lanka. KEY: Fischer 1938. DISCUSSION: *Petchiomyces* is apparently epigeous but is included here because of its traditional assignment to the Tuberales. Its relationship to genera of Pyronemataceae is unclear, but it seems akin to *Geopyxis* sensu Korf and thus is assigned to subfamily Ascophanoideae, tribe Geopyxideae (Korf 1972) for the present. *Petchiomyces kraspedostoma* Gilkey was originally described from a collection of mostly immature ascocarps. Extensive examination of the type collection has revealed that its mature spores are ornamented and that it conforms to the genus *Genea* in other respects as well, so it is recombined into that genus.

18. *Sphaerozone* Zobel 1854 sensu Korf 1972, monotype *S. tulasnei* Zob. [=*Sphaerozone ostiolatum* (Tul. & Tul.) Setchell].

Ascocarps pulvinate to globose, 0.5-1.5 cm in diam, yellow to brown or olive. *Peridium* lacking. *Asci* cylindric, with 8 uniseriate spores, nonamyloid, operculate, formed among paraphyses in a hymenial palisade covering the sporocarp surface. *Spores* globose, 8-25 µm in diam, echinulate or reticulate, hyaline to yellowish or brown. SPECIES: 4, North America, Europe, and Australia. KEY: No dependable key exists. DISCUSSION: The placement of this genus follows Korf (1972). I have not examined specimens.

Family BALSAMIACEAE Fischer 1897 emend. nov.

Ascocarps subglobose, smooth to verrucose. *Gleba* solid, with narrow, open or stuffed veins or with pockets of fertile tissue separated by veins of sterile but otherwise undifferentiated tissue. *Asci* cylindric to globose, nonamyloid, indehiscent, formed in a hymenial palisade or randomly embedded in tramal tissue or fertile pockets. *Spores* fusoid-apiculate to ellipsoid, smooth, hyaline to olivaceous. DISCUSSION: The family as emended includes three smooth-spored genera not readily assignable to other families of Pezizales with present evidence. *Barssia* and *Balsamia* have been placed in Tuberaceae and *Picoa* in Terfeziaceae by most authors (Fischer 1938, Gilkey 1954, Hawker 1954, Lange 1956). Both families sensu lato are polyphyletic.

19. *Barssia* Gilkey 1925, monotype *B. oregonensis* Gilkey. SYNONYMS: *Phymatomyces* Kobayasi 1937.

Ascocarps subglobose, some with an apical or lateral cavity, 1-4 cm in diam, smooth or erratically verrucose, glabrous to scabrous, yellowish pink to reddish brown. *Peridium* of large, interwoven hyphae or inflated cells.

Gleba solid, except for broad to narrow hymenium-lined veins. *Asci* cylindric to narrowly clavate, with 8 uniseriate to incompletely biseriate spores, nonamyloid, indehiscent, formed in a hymenial palisade among paraphyses. *Spores* oblong, 24-36 x 12-21 µm, or globose, 19-23 µm in diam, smooth, hyaline. SPECIES: 2, Pacific Northwestern United States and Japan. KEY: None exists. DISCUSSION: The type and only collection of *Phymatomyces yezo-montanus* Kobayasi was a casualty of World War II (Gilkey 1961). Its similarities to *Barssia* seem to exceed the differences, so the two monotypic genera are merged by the recombination *Barssia yezo-montána*.

20. *Balsamia* Vittadini 1831, lectotype *B. vulgaris* Vitt.
SYNONYMS: see Trappe (1975a). PLATE 1.

Ascocarps subglobose to irregular, 0.7-2(-4) cm in diam, sometimes with an apical or lateral cavity, verrucose, brownish orange to brown or black, often with a basal mycelial tuft but otherwise glabrous. *Peridium* of subangular to globose cells. *Gleba* with narrow, meandering, open or hypha-stuffed veins or labyrinthiform chambers lined with a palisade of paraphyses, white to pale yellow. *Asci* cylindric to broadly clavate or ellipsoid, with 8 clustered spores randomly embedded in the trama or occasional in the palisade of paraphyses lining glebal veins. *Spores* obtuse to ellipsoid, 13-42 x 10-18 µm, smooth or rarely with nearly submicroscopic radial lines, hyaline. SPECIES: 6, North America, Europe and North Africa. KEY: Hawker (1954) for European species, Gilkey (1954) for American species (including the genus *Pseudobalsamia*). No complete keys exist. DISCUSSION: *Balsamia* is a well defined genus that has suffered little confusion since it was described.

21. *Picoa* Vittadini 1831, lectotype *P. juniperi* Vitt.
SYNONYMS: see Trappe (1971).

Ascocarps subglobose to irregular, 1-7 cm in diam, roughened to verrucose, brown to black, glabrous or pubescent. *Peridium* of subangular to globose cells. *Gleba* solid, of fertile pockets separated by sterile but otherwise undifferentiated veins, the fertile pockets gray to olive or brown and the veins pallid. *Asci* ellipsoid to obovoid or globose, with 8 clustered spores, nonamyloid, indehiscent, embedded in glebal tissue. *Spores* apiculate-fusiform to subcitriform, ellipsoid, or globose, 25-105 x

19-43 µm, smooth, hyaline to olive or brown. SPECIES: 5, North America, Europe, West Asia, and North Africa. KEY: no inclusive keys exist. DISCUSSION: *Picoa* has traditionally been placed in the Terfeziaceae, but it appears to have no close phylogenetic relationship to the genus *Terfezia*.

Family GENEACEAE fam. nov.

Ascocarps hollow, the interior lined with peridium-like epithecia. *Asci* cylindric to clavate, 4-8 spored, nonamyloid, indehiscent, borne among paraphyses in continuous or interrupted hymenia. *Spores* ellipsoid or globose, papillate to echinulate, hyaline to pale brown. DISCUSSION: This family first appeared in the literature in the late 1930's but has never been validly described. Various authors have included various genera, but as described here it is restricted to *Genea* and *Genabea*.

22. *Genea* Vittadini 1831, lectotype *G. verrucosa* Vitt. SYNONYMS: see Trappe (1975a). PLATE 2.

Ascocarps globose to irregular, 0.3-2(-3) cm in diam, with an apical orifice to the hollow interior and mostly with a tuft of basal mycelium, light brown to black, verrucose, glabrous to tomentose. *Peridium* and epithecium of subangular to globose cells. *Gleba* a single, even to irregular chamber lined with an epithecium similar to the peridium and enclosing the white to gray trama and continuous or interrupted hymenial palisade. *Asci* cylindric to clavate, with 8 uniseriate spores, nonamyloid, indehiscent, borne in a hymenial palisade among paraphyses whose tips differentiate to form the epithecium. *Spores* ellipsoid to subglobose or rarely globose, 20-45 x 12-34 µm excluding ornamentation, smooth in youth but soon developing rounded to conic warts that dissolve in 5% KOH, hyaline. SPECIES: ± 24, North America and Europe. KEY: Gilkey (1954) for North American species, Fischer (1938) for European. Revised keys are badly needed for the entire genus. DISCUSSION: Relationships of *Genea* to genera of Pezizales have not yet been satisfactorily established.

23. *Genabea* Tulasne & Tulasne 1845a, monotype *G. fragilis* Tul. & Tul. SYNONYMS: see Trappe (1975a). PLATE 2.

Ascocarps subglobose to convoluted and knobby, 0.2-1.5(-2) cm in diam, often with an orifice to the convoluted, hollow interior, finely verrucose, lacking a basal mycelial tuft, yellowish gray to brown or black, glabrous. *Peridium* and epithecium of subangular to rounded, ± isodiametric cells. *Gleba* an irregular chamber lined with an epithecium similar to the peridium and enclosing the white to gray or yellowish gray trama and pockets of hymenia. *Asci* clavate to ellipsoid, with (1-)4-8 uniseriate to biseriate or clustered spores, nonamyloid, indehiscent, borne in a hymenial palisade among paraphyses whose tips differentiate to form the epithecium. *Spores* ellipsoid to globose, 26-53(-70) x 20-53(-70) µm excluding ornamentation, smooth in youth but soon developing prominent spines, grayish yellow to brown. SPECIES: 5, North America and Europe. KEY: Gilkey (1954) for North American species, Fischer (1938) for European. DISCUSSION: Relationships of *Genabea* to *Genea* are discussed by Trappe (1975a).

Family TERFEZIACEAE Fischer 1897 emend. nov.

Ascocarps solid, the gleba marbled with meandering veins of hymenia or isodiametric cells or tramal tissue that encloses fertile pockets. *Asci* cylindric to globose, with 4-8 uniseriate to clustered spores, nonamyloid, indehiscent, borne among paraphyses in a hymenial palisade or randomly embedded in tramal tissue. *Spores* globose, ornamented with rounded warts, cones, hollow rods, spines or an irregular reticulum, hyaline to pale brown. DISCUSSION: The past concept of the Terfeziaceae (Trappe 1971) has been based largely on gross morphology and thus has included disparate genera such as *Terfezia* with nonamyloid asci and globose, ornamented spores; *Picoa* with nonamyloid asci and variously shaped, smooth spores; *Amylascus*, with amyloid asci and globose, ornamented spores; and *Tirmania*, with amyloid asci and ellipsoid to globose, smooth spores. The latter three genera have been assigned to other families earlier in this paper. The family Terfeziaceae as emended here is based primarily on ascus and spore characteristics that provide a common thread through genera that have evolved progressively to spore dispersal by mycophagy. The Terfeziaceae appear to be related to the Pyronemataceae, but the connections are uncertain at present.

24. *Choiromyces* Vittadini 1831, monotype *C. meandriformis* Vitt. [=*C. venosus* (Fries) T. Fries]. SYNONYMS: see Trappe (1975a). PLATE 2.

Ascocarps subglobose to irregular, 1-10 cm in diam, smooth to verrucose, pale yellow to yellowish brown, glabrous to scabrous or pubescent. *Peridium* of broad interwoven hyphae, often with many cells inflated. *Gleba* solid, with white to pallid trama marbled with narrow, brownish yellow to brown veins filled by opposing hymenia and hyphae or occasionally open. *Asci* cylindric to clavate or saccate, mostly with 8 uniseriate to clustered spores, nonamyloid, indehiscent, formed among paraphyses in a hymenial palisade. *Spores* globose, 10-30 µm in diam excluding ornamentation, smooth in youth but soon developing a pitted epispore, minute projections, spines, or hollow-rods, hyaline to light brown. SPECIES: 5, North America, Europe, Africa, and Australia, including *C. aboriginum* sp. nov. KEY: no satisfactory keys exist. DISCUSSION: With its fertile hymenium, *Choiromyces* is the closest of the family to pezizaceous ancestors.

25. *Pachyphloeus* Tulasne & Tulasne 1845a, monotype *P. melanoxanthus* (Tul. in Berk.) Tul. & Tul. SYNONYMS: see Trappe (1975a). PLATE 2.

Ascocarps subglobose, 0.5-5 cm in diam, often with an apical depression or cluster of grooves, scabrous to verrucose, brownish yellow to yellowish green, red, or black, glabrous. *Peridium* of subangular to globose isodiametric cells. *Gleba* solid, grayish yellow to nearly black marbled with pallid veins that often tend to converge near the sporocarp apex. *Asci* cylindrical to clavate, ellipsoid, or subglobose, with 8 uniseriate to biseriate or clustered spores, nonamyloid, indehiscent, borne irregularly as a lining to veins or embedded randomly in glebal tissue. *Spores* globose, 14-21 µm in diam excluding ornamentation, smooth in youth but soon developing mucilage-embedded to free papillae or spines, hyaline to brown. SPECIES: 6, North America, Europe, and Japan. KEY: Gilkey (1954) for North America species, Hawker (1954) or Lange (1956) for European species. DISCUSSION: The verrucose peridium of isodiametric cells separates *Pachyphloeus* and *Hydnobolites* from other genera of the Terfeziaceae. Spores and ascus characters, however, suggest a relationship to *Choiromyces* on the one hand and *Terfezia* on the other.

26. *Hydnobolites* Tulasne & Tulasne 1843, monotype *H. cerebriformis* Tul. & Tul. PLATE 2.

Ascocarps irregular, 0.3-3 cm in diam, smooth, white to brown, glabrous to minutely scabrous. *Peridium* of ± isodiametric cells. *Gleba* solid, gray to yellowish brown marbled with veins lined with cells similar to those of the peridium. *Asci* saccate to ellipsoid or subglobose, with (4-)8 clustered spores, nonamyloid, indehiscent, borne randomly in tramal tissue. *Spores* globose, 12-24 µm in diam, smooth in youth but soon developing an alveolate reticulum, hyaline to pale brown. SPECIES: 2, North America and Europe. *H. californicus* Fischer is known only from North America. *H. cerebriformis* had been regarded as a strictly European species, but specimens collected in Iowa by Christopher Walker (personal communication) prove its presence in America as well. KEYS: Gilkey (1954) describes *H. californicus* and Hawker (1954) and Lange (1956) describe *H. cerebriformis*. DISCUSSION: This genus is close to *Pachyphloeus* on the one hand and to *Terfezia* on the other.

27. *Terfezia* (Tulasne & Tulasne) Tulasne & Tulasne, lectotype *T. leonis* Tul. & Tul. nom. illeg. [=*T. arenaria* (Moris) Trappe]. SYNONYMS: see Trappe (1975a). PLATE 2.

Ascocarps subglobose to turbinate or irregular, 2-10 cm in diam, smooth, brownish yellow to brown or brownish black, glabrous. *Peridium* of broad hyphae with inflated cells. *Gleba* solid, with yellowish to dark brown fertile pockets separated by paler but otherwise undifferentiated sterile tramal veins. *Asci* saccate to globose, with (3-)5-8 clustered spores, randomly embedded in tissue of fertile pockets. *Spores* globose, 14-55(-64) µm excluding ornamentation, smooth in youth but soon developing an ornamentation of mucilage-embedded or free spines, papillae, or a reticulum, light yellowish brown. SPECIES: 12, southern North America, South America, Central and Southern Europe, Africa, and Asia. KEY: Gilkey (1954) for American species, Fischer (1938) for European, African, and Asian species. The genus needs monographing and new keys. DISCUSSION: As the type genus for the family, *Terfezia* is closely related to other genera of the family in terms of anatomical characteristics, with the possible exception of *Delastria*.

28. *Delastria* Tulasne & Tulasne 1843, monotype *D. rosea* Tul. & Tul.

Ascocarps subglobose to turbinate or irregular, 1-3 cm in diam, even, white to nearly black, velvety to tomentose. *Peridium* absent or of interwoven hyphae with many inflated cells, sometimes entirely of isodiametric cells. *Gleba* of rosy to brown fertile pockets separated by pallid veins. *Asci* clavate to saccate, with 2-4 mostly uniseriate spores, nonamyloid, indehiscent, embedded randomly in tramal tissue. *Spores* globose, 23-35 µm excluding ornamentation, smooth in youth but soon developing an ornamentation that varies markedly from a broad reticulum to crowded spines, even between spores within an ascus. SPECIES: 1, southern Europe and north Africa. KEY: The single species of this genus is described by Fischer (1938). DISCUSSION: *Delastria* is an unusual genus in many respects. I place it in the Terfeziaceae because of its globose, ornamented spores, but its relationship to the family is more tenuous than that of the other genera.

Family TUBERACEAE Dumortier 1822 emend. nov.

Ascocarps solid, marbled with hypha-stuffed veins meandering through fertile tissue. *Asci* ellipsoid to globose, with 1-6 clustered spores, randomly embedded in tramal tissue. *Spores* ellipsoid to globose, spinose to geometrically reticulate, pale brown to dark brown, the spores in single-spored asci larger than those in multispored asci within a given sporocarp. DISCUSSION: The Tuberaceae sensu lato has been a catchall for genera that didn't fit other families as conceived by previous authors. As defined here, it includes only the genera *Tuber* (including *Lespiaultinia* and *Mukagomyces*) and *Paradoxa*. It differs most strikingly from the Terfeziaceae in spore characteristics.

29. *Tuber* Sibthorp ex Fries 1823, lectotype *T. cibarium* Sibth. ex Fries (=*T. brumale* Vittadini). SYNONYMS: see Trappe (1975a), also *Mukagomyces* Imai 1940 and *Lespiaultinia* Zobel 1854. PLATE 3.

Ascocarps subglobose to much lobed and irregular, 0.3-12 cm in diam, smooth to coarsely verrucose, with scattered or clustered, pubescent furrows, white to yellow, red, brown, or black, glabrous to pubescent or tomentose.

Peridium of interwoven hyphae or ± isodiametric cells or a mixture of both. *Gleba* solid, white to gray in youth but gradually becoming brown to black as spores mature, marbled with meandering, white to grayish yellow veins often lined in youth with an ephemeral, erratic to regular palisade of paraphyses that grow out to stuff the veins with interwoven hyphae, the veins occasionally opening to furrows on ascocarp surface. *Asci* ellipsoid to obovoid or globose, with 1-5(-6) clustered spores, nonamyloid, indehiscent, randomly embedded in glebal tissue. *Spores* ellipsoid to globose, 32-88 x 21-54 µm excluding ornamentation in single-spored asci, 21-52 x 15-38 µm in 4-spored asci (spore size within a given sporocarp varying inversely with number of spores/ascus), smooth in youth but soon developing an ornamentation of spines or an alveolate reticulum, brownish yellow to dark brown. SPECIES: ± 60 with a similar number of additional species epithets as synonyms. Cosmopolitan in association with ectomycorrhizal tree and shrub hosts. KEY: No existing keys can be recommended, because the genus badly needs monographing with special attention to sharpening of species concepts. DISCUSSION: The wide range of variations now known for this large genus easily encompass the small genera *Lespiaultinia* and *Mukagomyces*, the species of which are recombined as *Tuber* spp. here. *Mukagomyces*, indeed, appears to have been erected as a result of a misunderstanding of the terms "venae externae" and "venae internae" commonly used in describing the glebal structure of *Tuber* spp. Because such misunderstanding is widespread and because the terms have not been uniformly defined or applied, I avoid them altogether.

30. *Paradoxa* Mattirolo 1935, monotype *P. monospora* Matt.
PLATE 3.

Ascocarps subglobose to irregular, 0.4-1 cm in diam, smooth but with prominent furrows, brownish yellow to reddish brown, glabrous. *Peridium* of interwoven hyphae. *Gleba* solid, pallid in youth, by maturity blackish brown with pallid to brown meandering veins. *Asci* ellipsoid to globose, 1-spored, nonamyloid, indehiscent, randomly embedded in tramal tissue. *Spores* broadly ellipsoid to globose or occasionally irregular, 57-80 x 55-80 µm excluding ornamentation, smooth in youth but soon developing an alveolate reticulum, very dark brown at maturity. SPECIES: 1, Italy. DISCUSSION: *Paradoxa* has been placed in the Terfeziaceae sensu lato, but in anatomy and spore characteristics it is clearly related to *Tuber*.

Family CARBOMYCETACEAE Trappe 1971

31. *Carbomyces* Gilkey 1954, holotype *C. emergens* Gilkey. PLATE 3.

Ascocarps subglobose, 2-4 cm in diam, smooth, white to dull yellow or brown, glabrous. *Peridium* of interwoven, periclinal hyphae, with many cells inflated in the subcutis. *Gleba* solid, of brown fertile pockets separated by white to olive veins. *Asci* subglobose to globose, with 8 clustered spores, nonamyloid, indehiscent but disintegrating at maturity, brown, randomly embedded in tissue of fertile glebal pockets. *Spores* ellipsoid, 17-19 x 11-14 µm excluding ornamentation of spines, or globose, 10-19 µm and smooth, hyaline to pale brownish pink. SPECIES: 3, deserts of southwestern United States. KEY: Gilkey (1954) includes two of the three species. DISCUSSION: *Carbomyces* species apparently develop hypogeously but often emerge, dry out, and are blown about by wind. In the dry stage, the gleba is friable to powdery because the greatly inflated glebal cells collapse. Relationships of *Carbomyces* to other Ascomycotina are unknown.

NEW TAXA

ELAPHOMYCETALES *ordo nov. Cleistothecia 0.5-4 cm in diam, persaepe ectomycorrhizis involuta, cava vel pulvere sporarum repleta. Peridium crassum, carnosum, coriaceum vel carbonaceum, laeve vel manifeste verrucosum, cinnamomeum, indigoticum vel atrum, glabrum vel tomentosum. Asci globosi, octospori, inamyloidei, indehiscentes, evanescentes. Sporae globosae, spinosae vel reticulatae, fulvae, brunneae vel opacae. Monotypus: Elaphomycetaceae.*

GENEACEAE *fam. nov. Ascocarpia 0.5-2 cm in diam, globosa vel irregularia, cava, orificio; cavitas aequata vel irregularis, epithecio peridiaceo limitata. Peridium verrucosum, cerinum, brunneum, vinaceum vel atrum, glabrum vel tomentosum. Asci cylindrici vel late clavati, octospori, inamyloidei, indehiscentes, inter paraphyses in hymeniis inclusis continuis vel interruptis portati. Epithecium apicibus differentiatis paraphysium formatum. Sporae ellipsoideae vel globosae, verrucosae vel spinosae,* *hyalinae vel bruneolae. Genera duo: Genea (holotypus) et Genabea.*

CLELANDIA ARENACEA *gen. et sp. nov. Ascocarpia exsiccata ± 2 cm in diam, profunde sulcata. Peridium glabrum, pallide fulvum, arena adherenti velatum. Gleba loculis vacuis labyrinthinis, hymeniis limitatis. Asci cylindrici vel saccati, octospori, valde amyloidei. Sporae late ellipsoideae vel subglobosae, 10-12 x 8-10 µm in diam, dispersae, inferiores quam asci. Holotypus: ADW 15885.*

Etymology: In honor of the collector, Australian mycologist J. B. Cleland, Latin, *arenaceus* (sandy).

Ascocarps hypogeous or subhypogeous, as dried ± 2 cm in diam, deeply furrowed. *Peridium* glabrous, pale orange brown as dried but appearing dark reddish brown from adherent sand. *Gleba* pale brownish yellow, with empty, labyrinthine chambers lined with hymenia.

Spores broadly ellipsoid to subglobose, 10-12 x 8-10 µm, smooth, hyaline, with a single de Bary bubble; walls ± 1 µm thick. *Asci* cylindric to saccate, 90-120 x 12-25 µm, with 8 uniseriate to biseriate spores, hyaline, diffusely blue but reaction strongest at the tip in Melzer's reagent, thin-walled, tapered to a simple base, indehiscent, persistent, borne among paraphyses in the hymenia. *Paraphyses* 5-8 µm in diam, hyaline, thin-walled, septate, loosely scattered among and shorter than the asci.

Peridial and *gleba tissue* of hyaline, thin-walled inflated cells 20-100 µm in diam. *Subhymenium* rehydrating poorly, narrow, apparently of interwoven, hyaline, thin-walled hyphae ± 8-15 µm in diam. Known only from the arid central region of Australia.

Specimens examined: HOLOTYPE-AUSTRALIA, Northern Territory: Mt. Wedge Station, 25 Aug. 1957, col. J. B. Cleland (holotype ADW 15885, isotype OSC). PARATYPE-Haast's Bluff Reserve, 3 Sept. 1957, col. J. B. Cleland (ADW 8615).

DINGLEYA VERRUCOSA *gen. et sp. nov.* PLATES 1 and 4. *Ascocarpia exsiccata usque ad 3.5 cm in diam, subglobosa vel lobata. Peridium verrucosum, fragmentulis pubescentibus, brunneum. Gleba loculis labyrinthinis, hymeniis limitatis, sporis et ascis farctis. Asci* *cylindrici, pro parte maxima octospori, inamyloidei. Sporae ellipsoideae, 19-26 x 15-18 µm sine ornamentis; episporis 1-3 µm incrassatis, amorphis, brunneo-vinosis, nodosis et porcatis. Paraphyses ± 2 µm in diam, aequales vel inferiores quam asci. Holotypus: PDD 29712.*

Etymology: In honor of New Zealand mycologist Joan M. Dingley, who recognized the novelty of this species; Latin, *verrucosus* (warty).

Ascocarps hypogeous to subhypogeous, as dried up to 3.5 cm in diam, subglobose to lobed. *Peridium* verrucose with subangular warts 0.2-0.4 x 0.2-1.0 mm, small pubescent patches scattered among the warts, the thin epicutis brown and the thick subcutis yellowish white. *Gleba* yellowish white, with labyrinthine chambers 0.2-1 mm broad and completely stuffed with asci and spores from adpressed hymenia.

Spores ellipsoid, smooth in youth, 19-26 x 15-18 µm excluding ornamentation, 32-38 x 20-28 µm including ornamentation at maturity of a vinaceous brown, amorphous epispore 1-3 µm thick with rounded knobs and ridges 4-12 x 2-5 µm, the knobs on spore ends frequently larger than those on the sides. Spore walls strongly cyanophilic, at maturity the epispore cyanophilic but strongly so only on the outer sides of the knobs and ridges. *Asci* cylindric, mostly 230-280 x 25-30 µm, mostly with 8 uniseriate spores, hyaline, nonamyloid, thin-walled, tapered to a broadly croziered base, indehiscent, persistent, borne among paraphyses in the hymenia. *Paraphyses* ± 2 µm in diam, hyaline, thin-walled, frequently septate, straight, round-tipped, equaling or shorter than the asci.

Peridial tissue with an epicutis 50-150 µm thick, of ± isodiametric cells 10-25(-30) µm in diam, with yellowish brown walls 2-3 µm thick, grading to the subcutis of interwoven, hyaline hyphae 4-6 µm in diam. *Glebal tissue* similar to that of subcutis. *Subhymenium* of interwoven, hyaline, thin-walled hyphae 4-8 µm in diam with occasional cells inflated to 10-12 µm.

Known only from North and South Islands, New Zealand.

Specimens examined: HOLOTYPE-NEW ZEALAND, *North Island,* Auckland District: Waima, Hokianga, 21 Sept. 1966, col. R. A. Cumber (holotype PDD 29712, isotype OSC).

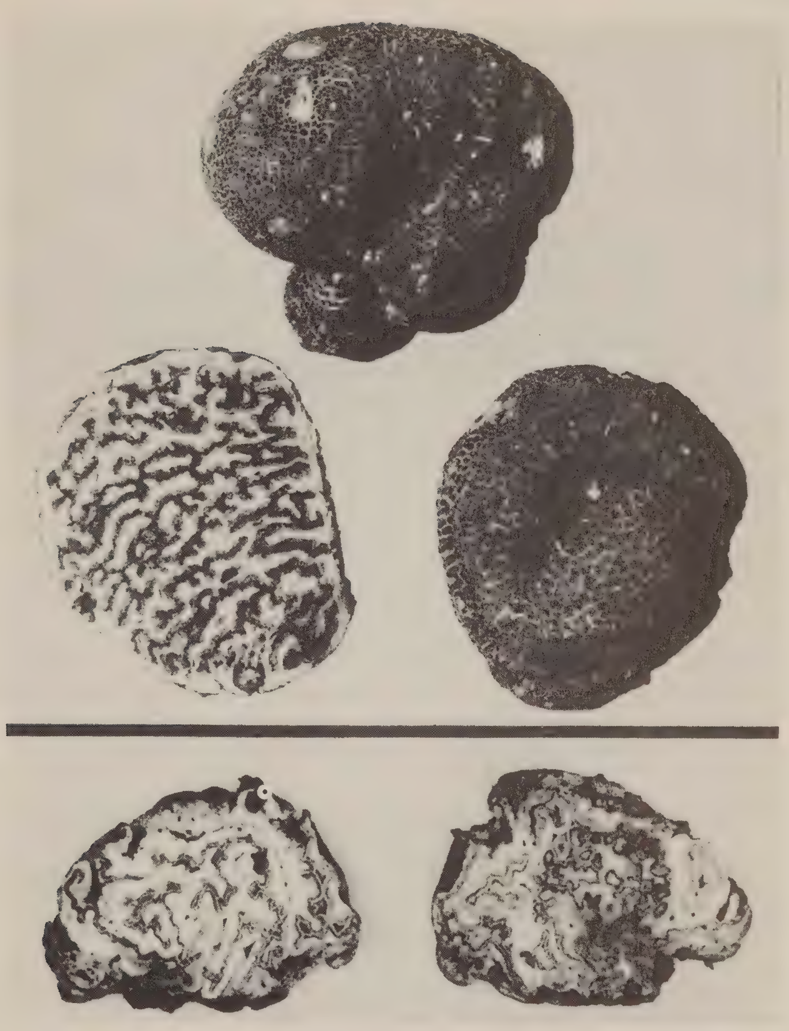


PLATE 4.--Fresh sporocarps of hypogeous Ascomycotina, about natural size. (ABOVE) *Dingleya verrucosa* sp. nov., cross section (left) and two surface views. Photo #14360 by A. Underhill, Plant Diseases Division, D.S.I.R., Auckland, N.Z. (BELOW) *Peziza stuntzii* sp. nov., two cross sections. U.S. Forest Service Photo by R. Molina.

PARATYPES-NEW ZEALAND, *North Island*, Auckland District: Titirangi, Nov. 1931, col. M. Hodgkins, PDD 29714; Titirangi, Atkinson Park, 3 July 1966, col. R. F. R. McNabb, PDD 29710. *South Island*, Westland District, Longford, Buller Gorge, March 1931, col. M. Bowland, PDD 29711.

CHOIROMYCES ABORIGINUM sp. nov. Ascocarpia usque ad 7x5 cm, subglobosa vel turbinata, profunde sulcata vel lobata, mollia. Peridium glabrum, album vel cremeum. Gleba alba, loculis labyrinthinis, hymeniis limitatis, sporis et ascis farctis. Asci claviti vel saccati, octospori, inamyloidei. Sporae subglobosae vel globosae, 9.5-13.5 x 8.5-12.5 µm sine ornamentatis, hyalinae, projecturis congestis 0.1 x 0.1 µm. Paraphyses 3-5 µm in diam, dispersae, sinuosae. Holotypus: MELU, leg. Donald Thompson, VIII 1958.

Etymology: Latin, genitive of Aborigines (original inhabitants), referring to the use of this truffle by the Australian aborigines (McLennan 1961).

Ascocarps subhypogeous to hypogeous, up to 7 x 5 cm, subglobose to turbinate, deeply furrowed and lobed, soft. *Peridium* smooth, glabrous, white to pale cream colored. *Gleba* white to pale cream colored, with narrow labyrinthine chambers filled by opposing hymenia or, when broader, stuffed with hyphae.

Spores subglobose to globose, 9.5-13.5 x 8.5-12.5 µm excluding ornamentation of minute, crowded projections, hyaline. Spore walls 1.5-2 µm thick. *Asci* clavate to saccate, 90-150 x 15-30 µm, with 8 uniseriate to biseriate or clustered spores, hyaline, nonamyloid, thin-walled, with a long tapered stem, indehiscent, borne among paraphyses in the hymenium. *Paraphyses* 3-5 µm in diam, hyaline, thin-walled sinuous, scattered among the asci.

Peridial tissue of interwoven hyaline, thin-walled hyphae 3-10 µm in diam with many cells inflated to 15-20 µm and scattered to abundant sphaerocysts 40-120 µm in diam. *Glebal tissue* and *subhymenium* similar to peridial tissue except with only few inflated cells and sphaerocysts; hyphal stuffing of chambers with abundant inflated cells and sphaerocysts.

Known only from the central Australian desert.

Specimens examined: HOLOTYPE-AUSTRALIA, Western Australia: near Lake Hazlett, Aug. 1958, col. Donald Thompson (holotype MELU, isotype OSC).

Discussion: McLennan (1961) described this collection as the basis for her new genus *Elderia*, but she designated *Stephensia arenivaga* Cooke & Massee as the type collection. *C. aboriginum* differs from *S. arenivaga* in having a glabrous rather than tomentose peridium, ornamented rather than smooth spores, and abundant sphaerocysts. Sphaerocysts do not occur in other species of *Choiromyces*, so *C. aboriginum* may eventually merit erection of a separate genus. Inflated cells are common in desert truffles, however, and thus may represent a special adaptation to that environment.

PEZIZA STUNTZII sp. nov. PLATE 4. *Ascocarpia usque ad 3 x 5 cm, irregularia, profunde sulcata. Peridium scabrum, carneum. Gleba carnea, solida, venis brunneis marmorata, venae saepe ad paginam apertae. Asci cylindrici, octospori, amyloidei (fortissime ad aspices), ad apices indentati. Sporae ellipsoideae, 12-15 x 10-12* µm *sine ornamentis verrucarum et cristularum ± 0.5 x 0.5 µm, hyalinae. Paraphyses 3-8 µm in diam, apicibus clavatis. Holotypus: Trappe 4818 (OSC).*

Etymology: In honor of Dr. Daniel E. Stuntz.

Ascocarps hypogeous, up to 3 x 5 cm, irregular, deeply furrowed. *Peridium* scabrous, flesh pink. *Gleba* solid, flesh pink, marbled with brown veins mostly filled with hymenia and often opening to the surface. Odor of spicy sausage.

Spores ellipsoid, 12-15 x 10-12 µm excluding the ornamentation of cyanophilic warts and short ridges ± 0.5 x 0.5 µm, hyaline. *Asci* cylindric, 230-26 x 11-16 µm, with 8 uniseriate spores, hyaline, the apical half strongly blue in Melzer's reagent, apices indented or sometimes with a circumferential line, the bases croziered. *Paraphyses* 3-8 µm in diam, with clavate tips.

Peridial tissue a palisade of frequently septate hyphae 7-25 µm in diam, with obtuse to clavate tips. *Glebal tissue* of loosely interwoven hyphae 7-20 µm in diam with abundant rounded to subangular cells 10-45 µm in diam. *Subhymenium* of tightly interwoven hyphae 6-15 µm in diam.

Known only from the type collection in a mixed woods of *Pseudotsuga menziesii* and *Quercus garrayana*, elev. ca. 550 m.

Specimens examined: HOLOTYPE-U.S.A., Washington, Yakima Co., Tieton River Valley, Windy Point Forest Camp, 28 Oct. 1976; Trappe 4818 (OSC).

Discussion: P. stuntzii more closely approaches the typical truffles in form than do most sparassoid Pezizales as discussed by Korf (1973). I did not find indisputable opercula, but the ascus apices are structured for them. In any event, all other anatomical features clearly relate the species to the genus *Peziza*.

NEW COMBINATIONS AND RANKS

BARSSIA YEZO-MONTANA (Kobayasi) comb. nov.
Basionym: *Phymatomyces yezo-montanus* Kob., J. Jap. Bot. 13:913-914, 1937.

ELAPHOMYCES subgen. *ASCOSCLERODERMA* Clémencet status nov.
Basionym: *Ascoscleroderma* Clémencet, Le Bot. 24: 14-36, 1932.

GENEA KRASPEDOSTOMA (Gilkey) comb. nov.
Basionym: *Petchiomyces kraspedostoma* Gilkey, Oreg. State Monogr. Stud. Bot. 1:15, 1939.

LABYRINTHOMYCES VARIUS (Rodway) comb. nov.
Basionym: *Stephensia varia* Rodw., Roc. Soc. Tasmania Proc. 1897:129-130, 1897.

PEZIZA ELLIPSOSPORA (Gilkey) comb. nov.
Basionym: *Hydnotrya ellipsospora* Gilkey, Univ. Cal. Publ. Bot. 6:307, 344, 1916.

TUBER HIROMICHII (Imai) comb. nov.
Basionym: *Mukagomyces hiromichii* Imai, Proc. Imp. Acad. Tokyo 16:154, 1940.

TUBER OLIGOSPERMUM (Tulasne & Tulasne) comb. nov.
Basionym: *Terfezia oligosperma* Tul. & Tul., Fungi hypogaei, p. 176, 1851.

TUBER PHLEBODERMUM (Gilkey) comb. nov.
Basionym: *Delastriopsis phleboderma* Gilkey, Oreg. State Monogr. Stud. Bot. 1:49, 1939.

ACKNOWLEDGEMENTS

These studies were supported in part by National Science Foundation Grant GB-27378 and American Philosophical Society Penrose Grant 4439. As my teacher in mycology, Dr. Daniel E. Stuntz provided the original inspiration and enthusiasm that propelled me into this fascinating field of science. Spore drawings are by Jackie Atzet.

INDEX TO GENERA AS NUMBERED IN TEXT

Amylascus - 9
Ascoscleroderma - 1
Balsamia - 20
Barssia - 19
Carbomyces - 31
Caulocarpa - 5
Choiromyces - 24
Clelandia - 7
Delastria - 28
Densocarpa - 11
Dingleya - 3
Elaphomyces - 1
Elderia - 11
Fischerula - 4
Genabea - 23
Genea - 22
Geopora - 12
Hydnobolites - 26
Hydnocystis - 13
Hydnotrya - 2
Hydnotryopsis - 8
Labyrinthomyces - 15
Lespiaultinia - 20
Mukagomyces - 29
Pachyphloeus - 25
Paradoxa - 30
Paurocotylis - 16
Petchiomyces - 17
Peziza - 6
Phymatomyces - 19
Picoa - 21
Sarcosphaera - 5
Sphaerosoma - 11
Sphaerozone - 18
Stephensia - 14
Terfezia - 27
Tirmania - 10
Tuber - 29

REFERENCES

Auerswald, B. 1869. *Sarcosphaera* Awd., novum genus Discomycetum. Hedwigia 8:82-83.

Beaton, G. and G. Weste. The genus *Labyrinthomyces*. Trans. Brit. Mycol. Soc. 69:243-247.

Berkeley, M. J., and C. E. Broome. 1846. Notices of British hypogeous fungi. Ann. Mag. Nat. Hist. 18:73-82.

Boedijn, K. B. 1939. The Tuberales of the Netherlands Indies. Bull. Jard. Bot. Buitenzorg Ser. 3, 16:236-244.

Burdsall, H. H., Jr. 1968. A revision of the genus *Hydnocystis* (Tuberales) and of the hypogeous species of *Geopora* (Pezizales). Mycologia 60:496-525.

Chatin, A. 1890. Contribution à l'histoire naturelle de la truffe. Compt. Rend. Acad. Sci. Paris 111:947-953.

Clémencet, M. 1932. Contribution à l'étude du développement et de l'anatomie des Ascomycètes hypogés. Les Elaphomycétacées. Le Botaniste 24:3-105.

Corda, A. J. C. 1842. Anleitung zum Studien der Mycologie. Friedrich Ehrlich, Prague. 223 p.

Dennis, R. W. G. 1974. New or interesting British microfungi, III. Kew Bul. 30:345-365.

Dietrich, A. 1839. Flora regni borussici, Plates 433-504.

Dodge, C. W. 1929. The higher Plectascales. Ann. Mycol. 27:145-184.

Dumortier, B.-C. 1822. Commentations botanicae. Tournay.

__________. 1829. Analyses des familles des plantes. J. Casterman, Aine, Tournay. 104 p.

Eckblad, F.-E. 1968. The genera of operculate Discomycetes. Nytt Mag. Bot. 15:1-191.

Fennell, D. I. 1973. Plectomycetes: Eurotiales. *In* Ainsworth, G. C., F. K. Sparrow, and A. S. Sussman (eds.), The Fungi IV A. Academic Press, New York. pp. 45-68.

Fischer, E. 1897. Tuberaceen und Hemiasceen. Rabenhorst's Kryptog.-Flora Deutschlands, Österreich und der Schweiz, ed. 2 1, V(5):3-81.

__________. 1938. Tuberineae. Engler and Harms Nat. Pflanzenfam. ed. 2, 5b(8):1-42.

Fries, E. 1822. Systema mycologicum 2(1):1-274.

__________. 1823. Systema mycologicum 2(2):275-620.

___________. 1829. Systema Mycologicum 3(1):1-260.

Gilkey, H. M. 1916. A revision of the Tuberales of California. Univ. Cal. Publ. Bot. 6:275-356.

___________. 1925. Five new hypogaeous fungi. Mycologia 17:250-254.

___________. 1947. New or otherwise noteworthy species of Tuberales. Mycologia 39:441-452.

___________. 1954. Tuberales. North Amer. Flora 2, 1:1-36.

___________. 1961. New species and revisions in the order Tuberales. Mycologia 53:215-220.

Harkness, H. W. 1885. Fungi of the Pacific Coast. Bull. Cal. Acad. 1: 159-176.

Hawker, L. E. 1954. British hypogeous fungi. Phil. Trans. Roy. Soc. London 237:429-546.

Imai, S. 1940. Second note on the Tuberales of Japan. Proc. Imp. Acad. Tokyo 16:153-154.

Kimbrough, J. W. 1970. Current trends in the classification of Discomycetes. Bot. Rev. 36:91-161.

Kobayasi, Y. 1937. *Phymatomyces*, a new genus of the Tuberaceae. J. Jap. Bot. 13:912-914.

___________. 1963. On a new genus *Protogenea* of the Tuberales. Trans. Mycol. Soc. Japan 4:119-120.

Korf, R. P. 1972. Synoptic key to the genera of the Pezizales. Mycologia 64:937-994.

___________. 1973a. Sparassoid ascocarps in Pezizales and Tuberales. Rep. Tottori Mycol. Inst. 10:389-403.

___________. 1973b. Discomycetes and Tuberales. *In* Ainsworth, G. C., F. K. Sparrow, and A. S. Sussman (eds.), The Fungi IV A. Academic Press, New York. pp. 249-319.

Lange, M. 1956. Danish hypogeous fungi. Dansk Bot. Ark. 16:1-84.

Malençon, G. 1973. Champignons hypogés du nord de l'Afrique - I. Ascomycetes. Persoonia 7:261-288.

Mattirolo, O. 1928. Secondo elenco dei "Fungi Hypogaei" raccolti nelle Foreste de Vallombrosa (1900-1926). Nuovo Giorn. Bot. Ital. n.s. 34:1343-1358.

___________. 1935. Catalogo ragionato dei funghi ipogei raccolti nel Canton Ticino e nelle provincie italiane confinanti. Contr. Flora Crittogama Svizzera 8(2):1-53.

McLennan, E. I. 1961. Australian Tuberales. Proc. Roy. Soc. Victoria 74:111-117.

Rodway, L. 1897. Tasmanian fungi. Roy. Soc. Tasmania Proc. 1897: 129-144.

Shaffer, R. L. 1968. Keys to genera of higher fungi. Ed. 2, Univ. Mich. Biol. Sta., Ann Arbor. 131 p.

Smith, A. H. 1973. Agaricales and related secotioid Gasteromycetes. *In* Ainsworth, G. C., F. K. Sparrow, and A. S. Sussman (eds.), The Fungi IV B. Academic Press, New York. pp. 421-450.

Trappe, J. M. 1971. A synopsis of the Carbomycetaceae and Terfeziaceae (Tuberales). Trans. Brit. Mycol. Soc. 57:85-92.

____________. 1975a. Generic synonyms in the Tuberales. Mycotaxon 2: 109-122.

____________. 1975b. The genus *Fischerula* (Tuberales). Mycologia 67: 934-941.

____________. 1975c. The genus *Amylascus* (Tuberales). Trans. Brit. Mycol. Soc. 65:496-499.

Tulasne, L.-R. and C. Tulasne. 1843. Champignons hypogés de la famille des Lycoperdacees, observés dans les environs de Paris et les Départements de la Vienne et d'Indre-et-Loire. Ann. Sci. Nat. Ser. 2, 19:373-381.

____________. 1845a. Fungi nonnulli hypogaei, novi v. minus cogniti. Giorn. Bot. Ital. 2, Pt. 1(7/8):55-63.

____________. 1845b. Mémoire pour servir à l'histoire des champignons hypogés suivi de leur monographie et accompagné de planches. Comp. Rend. Acad. Sci. Paris 21:1432-1436.

____________. 1851. Fungi hypogaei. Friedrich Klincksieck, Paris. 222 p.

Vittadini, C. 1831. Monographia Tuberacearum. Felicis Rusconi, Milano. 88 p.

Zobel, J. B. 1854. A. C. J. Corda, Icones Fungorum hucusque cognitorum 6:1-91.

MYCOTAXON

Vol. IX, No. 1, pp. 341-347 June 12, 1979

THE STIRPS COHAERENS OF *MARASMIUS*

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The agarics which revive when moistened, have ± white spore deposits, and tough often hairlike stipes, have presented great difficulty to taxonomists attempting to discern phylogenetic relationships among the various taxa. In the last twenty five years much has been done to clarify concepts in this group at the species level, but much still remains to be done. For instance, the fact that a few species of *Marasmius* have amyloid spores is now, following Singer (1975) or Gilliam (1976), considered sufficient for excluding them from the genus. This is done in spite of the fact that in other genera of the Tricholomataceae such as *Cystoderma* Fayod, we have species, one with and one without amyloid spores but otherwise remarkably similar in all their other basic features. One subject of a general nature which will command critical attention in the foreseeable future is the degree of variability in microscopic characters as this relates to the use of various features in proposing species and generic concepts.

It should be kept in mind that the hypha is the basic unit of structure of all agaric fruiting bodies and that the same environmental pressures are likely to produce the same changes in the various groups of agarics as these are based on spore and hyphal characters. Thus we find that narrow hyphae in the cuticle of the pileus are a feature of many unrelated (relatively) species. In some of these the hyphae will become gelatinized and in others not, or in some the hyphae will excrete slime but the walls will not gelatinize -- but in both types a viscid pileus will result; or one may find that both features, the breakdown of the hyphal wall and the excretion of slime, may take place in the caps of a single species. In the present states of our knowledge of agarics, situations like this complicate the problem of recognizing true relationship in the order Agaricales. We must not only learn to recognize a character exhibited by a fungus, but also know something of its origin before we claim to have correctly perceived its phylogenetic significance. Another illustration of changes in our viewpoint relative to the phylogenetic significance of a character, is in that involving spore ornamentation. Smooth spored as contrasted to species with ornamented spores have in some instances been regarded as relatively unrelated (in the Boletaceae for instance). This conclusion was arrived at with data obtained with the light microscope. Later, with the aid of SEM some "smooth spored" species were found to have distinctly ornamented spores. Thus the problems of phylogeny must be reexamined periodically as more data are gathered and new techniques are developed.

One approach to the problem of studying the marasmioid agarics as well as other groups is to recognize and define small groups of obviously closely related species as arrived at on the basis of all the characters known (overall similarities), and to gradually construct a system of classification with such groups as the foundation stones. The unofficial category of stirps is ideal for this since it can be adjusted to new information without extensive bookkeeping on the officially recognized genera, species, subspecies, varieties and forms. A stirps bears the specific epithet of its central species, as indicated in the title of this contribution. The following example of a stirps involves three Michigan species and one of southeastern distribution. The concept of the stirps and its name, have been widely but not frequently used in taxonomic botany for at least fifty years.

Stirps *Cohaerens*

The central and most widely known species, *Marasmius cohaerens* (Pers. ex Fr.) Cooke & Quélet, is a marasmioid species featuring, among other characters the thick-walled setalike pleurocystidia with ± rusty brown walls. In addition to the central feature of the pleurocystidia, it features a mat of basal mycelium, a more or less cartilaginous to horny ± polished stipe, and the occurrence of basidiocarps typically in clusters on a woody substrate. The cells of the pilear cuticle are smooth to branched as Gilliam (1976) has correctly pointed out.

A second species, *Marasmius cystidiosus* (Smith & Hesler) Gilliam, is southeastern in distribution, but rather similar to *M. cohaerens* in general features. It has both thin- and thick-walled pleurocystidia and their walls are hyaline to very slightly colored (as revived in KOH). It occurs on humus scattered to gregarious or in small groups, a basal mat of white mycelium is only weakly developed, the taste of the raw context is bitter, and the pileus cuticle is a palisade of clavate cells. It is distinct from *M. cohaerens* in having pleurocystidia with paler to hyaline walls, in being terrestrial, and in having a bitter taste. In describing the species Smith & Hesler (1940) stated of the pleurocystidia: "the walls usually thickened" (p. 306). Gilliam (l.c. p. 48) described them as: "with hyaline to pale yellow thin walls". The cystidia are extremely variable in size and shape, however, as described by Gilliam as well as the original authors. Because of the relatively fleshy nature of the basidiocarps, Smith & Hesler did not compare the species with those of *Marasmius* at the time they described it.

A third species, *Marasmius leighii* Smith occurs in dense clusters on wood, has thick-walled ± hyaline setalike pleurocystidia, a basal mat of mycelium around the cluster, and a mild to weakly nauseous (not bitter) taste. It is closer to *M. cystidiosus* in cystidial features than to *M. cohaerens*, as indicated by Gilliam who considered it synonymous with *M. cystidiosus*. Smith previously (in 1929) and under Kauffman's direction identified this species as *Marasmius fasciatus* Pennington. For a clarification of the nomenclature relative to *M. fasciatus* see Gilliam (1976).

The last species, *Marasmius delectans* Morgan, differs from all the above in its white pileus. It has thick-walled pleurocystidia and the basidiocarps are bound to each other to some extent by a mat of mycelium in the fallen leaves and humus. It also has the polished cartilaginous stipe. These four species appear to me to be closely related on the basis of all their characters, but at the same time have a central character to focus on them as a group. In Gilliam's treatment *M. cystidiosus*, and by implication *M. leighii*, are placed in Section *Globulares* and *M. cohaerens* and *M. delectans* are in section *Sicci*. To me these four species (all of which I have studied in the fresh condition) should be placed in the same section and in the same stirps. The concept of a stirps is marked by the degree of relationship of the species included in it rather than by any particular number included. There are genera that might well be regarded as a single stirps.

Key to Species of Stirps Cohaerens

1. Pileus white or whitish. . . . . *M. delectans* (pl.3): see Gilliam p. 54 for description.
1. Pileus brown to grayish brown. 2
2. Taste of raw context bitter. . . *M. cystidiosus* (see fig. 8, S. & H.)
2. Taste of raw context mild or slight. 3
3. Pleurocystidia setalike and ± rusty brown in KOH or H_2O. . . . *M. cohaerens* (pl.2; see Gilliam p. 64 for description).
3. Pleurocystidia setalike but mostly hyaline . . . . *M. leighii* Smith pl.1

Marasmius cystidiosus (Smith & Hesler) Gilliam, Mycotaxon 4: 47. 1976 (*Collybia cystidiosa* Smith & Hesler, Journ. Elisha Mitchell Sci. Soc. 56:4050. 1940.)

Pileus 2-5 cm broad, convex or with an obtuse umbo, margin incurved at first, spreading in age, slightly hygrophanous, when moist watery avellaneous, spreading in age, slightly hygrophanous, when moist watery avellaneous to near "pinkish buff" (usually grayer than pinkish buff), often translucent-striatulate on the margin, becoming opaque in age, "Sayal brown" to "ochraceous tawny" on the disc, the margin remaining pinkish buff, surface rugulose after fading or finally rugose-pitted or reticulate; context thin, white, cartilaginous, odor pungent (sometimes faint), taste bitter.

Lamellae rounded and attached by a basal tooth or appearing free, sometimes deeply and narrowly adnexed, moderately close to subdistant, narrow (2.5 mm ±), whitish, edges pruinose from cystidia (under a lens), sometimes with reddish brown stains in age.

Stipe 3-8 cm long, 3-6 mm thick, equal, strict, tubular, fragile, polished and translucent, not striate (at least at first), whitish above, tinged brownish at base, base sometimes slightly enlarged and white mycelioid.

Spore deposit white; spores 7-10 x 3-4µm, narrowly ellipsoid to subcylindric, smooth, yellowish in Melzer's. Basidia 4-spored, 20-25 x 5-6µm. Pleurocystidia very abundant, 32-80 x 8-15µm, fusoid-ventricose to ± versiform, many lanceolate in age, the bases usually curved, originating in the subhymenium, walls hyaline and usually thickened. Cheilocystidia scattered, 28-35 x 7-9µm, smooth, walls somewhat thickened, clavate to subcylindric or tapered to the apex.

Gill trama of subparallel hyphae reddish brown in Melzer's. Pileus trama homogeneous beneath a cuticle formed by a palisade of clavate to inflated cells 10-25 x 8-15µm reddish brown in Melzer's. Clamp connections present.

Scattered on humus in a mixed forest, Indian Creek, N. C., Great Smoky Mts. National Park, Sept. 6, 1937 (Smith 7416 and 7437, Aug. 14, 1938, Smith 10167; Smith 12195 (coll. by Hesler), July 30, 1939.)

Observations. Since this species was found frequently and never exhibited the fasciate pattern of fruiting-body occurrence, the pattern of occurring scattered on humus cannot be dismissed as an accidental happening. The above description is from the type and other collections made in the Great Smoky Mountains area.

Marasmius leighii sp. nov. Pl. 1.

Pileus 2-4 (6) cm latus, demum plano umbonatus, lubricus demum siccus, pallide alutaceus demum subfulvus, sapor mitis; lamellae angustae confertae demum pallide alutaceae; stipes 6-12 cm longus, (2) 3-6 (8) mm crassus, cartilagineus, deorsum fulvus, sursum pallidus vel pallide alutaceus; sporae 7-9 (10.5) x (2.5) 3-3.5µm, non-amyloidiis; pleurocystidia 36-70 x 3-8 (12)µm, ± crasso-tunicata, subhyalina. Specimen typicum in Herb. Univ. Mich. conservatum est, legit prope Ann Arbor Smith n 15213.

Pileus 2-4 (6) cm broad, expanding to campanulate to ± convex, in age nearly plane or with a slight umbo, moist but soon dry, or lubricous at first at times; colors "clay color" to "tawny olive" when fresh or young (clay color to pale spadiceous), on margin "pinkish buff" or paler, disc (or umbo) clay color to dull fulvous in age, glabrous, in fading becoming radially rugulose and with small depressions (inconspicuously alveolate) over the broad marginal area; context white, ± watery when fresh, thin, odor fungoid to mild, taste mild or becoming subnauseous but not bitter.

Lamellae narrow to (finally) moderately broad, crowded, adnate-sededing, pale buff (± "pinkish buff") or finally darker, unchanging where injured, edges entire.

Stipe 6-12 cm long, (2) 3-6 (8) mm thick, bases often bound together by white mycelium, terete or compressed, strict, cartilaginous, at times twisted-striate, pallid above and gradually pale tan to dull fulvous downward.

Spores 7-9 (10.5) x (2.5) 3-3.5µm, narrowly lanceolate to base, smooth, non-amyloid, hyaline in KOH. Basidia 4-spored. Pleurocystidia 36-70 x 3-8 (12)µm, hyaline, mostly with thickened walls, refractive in KOH, subfusoid, apex often nipple-like, arising in the subhymenium and basal third often curved. Cheilocystidia similar to (but often smaller than) the pleurocystidia. Gill trama parallel, reddish in Melzer's, the cells tubular to somewhat inflated. Pileus cuticle a hymeniform palisade of clavate cells some with slightly thickened walls at least in the pedicle. Clamp connections present.

Habit, habitat and distribution. Typically in dense clusters on decaying hardwood, summer, southern Michigan.

Observations. As far as observed to date this species has a consistently different fruiting pattern than that of *M. cystidiosus*, has a mild (not bitter) taste, and few clavate cheilocystidia. It is named in honor of Prof. L. H. Pennington who first recognized it as a species.

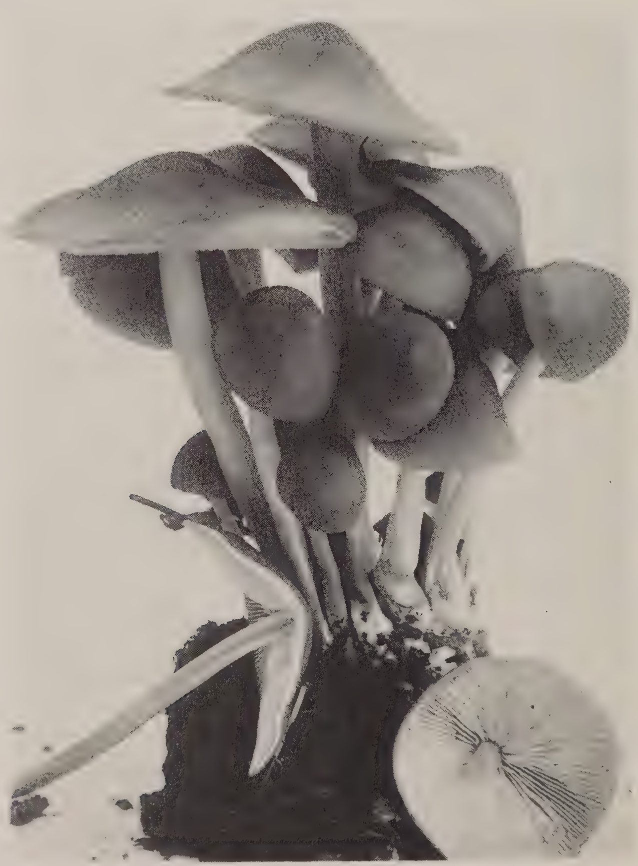
Literature Cited

Gilliam, Martina S. (1976). The genus Marasmius in the northeastern United States and adjacent Canada. Mycotaxon 4: 1-144.

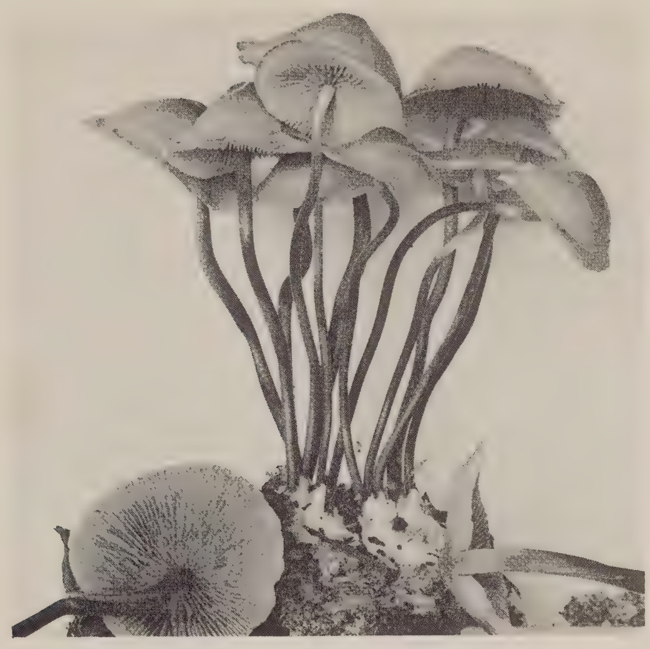
Pennington, L. H. (1915). Marasmius Fries. North Amer. Flora 9: 250-286.

Smith, Alexander H. and L. R. Hesler. (1940). New and Unusual Agarics from the Great Smoky Mountains National Park. Journ. Elisha Mitchell Sci. Soc. 56: 302-324.

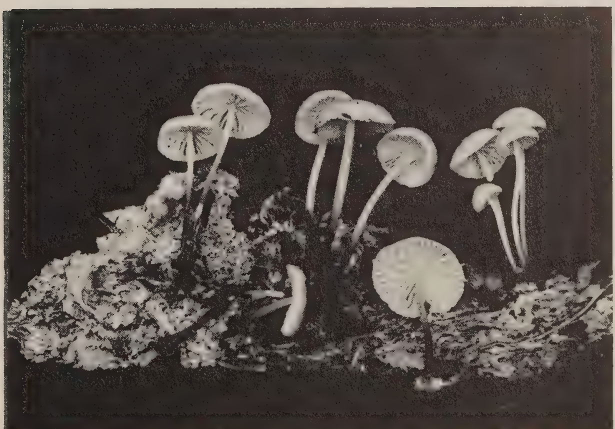
Singer, Rolf. (1975). The Agaricales in Modern Taxonomy. 912 p. Third Edition. J. Cramer, Vaduz.



Pl. 1. *Marasmius leighii* x 1 (type)



Pl. 2. *Marasmius cohaerens* x 1 (Smith 1514)



Pl. 3. *Marasmius delectans* x 1 (Smith 1709)

MYCOTAXON

Vol. IX, No. 1, pp. 348-357 June 12, 1979

THE SECTIONS OF *COPRINUS* PRESENT IN THE WESTERN UNITED STATES

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SUMMARY

The seven sections of the genus Coprinus occurring in the western United States are described and the principal criteria important in delimiting these sections are discussed. A key to the sections is provided.

Species of the genus Coprinus which have been examined from the western United States appear to fit well into the basic infrageneric taxa proposed by Kühner and Romagnesi (1953). The degree of agreement would seem to indicate that the criteria they used are in large measure applicable to species from widely separated areas, and their infrageneric taxa, with minor changes, probably will become the framework for future monographic treatments.

A primary division of Coprinus into two large groups of species is made on the basis of the pileal surface under any detersile velar layers. The pileal surface is composed of either radially oriented elongate elements or a cellular to hymeniform layer. The species in each of these two groups are further divided into sections on the

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[1] This paper is based in part on a thesis submitted to the Graduate School of the University of Washington in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

kind of velar structures present, the presence or absence of pilocystidia, and on the kinds of cells present in the universal veil. Seven sections are thus recognized.

Sections *Coprinus*, *Atramentarii*, *Lanatuli*, *Setulosi*, *Micacei*, and *Hemerobii* are delimited in essentially the same manner as in Kühner and Romagnesi (1953). Section *Picacei* as presented in this paper, however, combines species Kühner and Romagnesi referred to *Impexi* and *Vestiti*, since no essential differences could be detected in type of pileal surface, veils, spores, and other characteristics of these latter two taxa.

In identifying collections of *Coprinus* species to the following sections, several features must be determined: (1) the nature of the pileal surface below any velar elements, (2) the morphological nature of the veil elements themselves, and (3) the presence or absence of pilocystidia and caulocystidia. Failure to determine the presence and the nature of these features makes identification of species difficult or impossible.

KEY TO SECTIONS OF *COPRINUS* PRESENT IN THE WESTERN UNITED STATES

A. Pileal surface below any detersile velar elements readily seen to be composed of radially oriented hyphae or veil adherent and masking the pileal surface, no pilocystidia or caulocystidia present .... B

A. Pileal surface below the detersile velar elements readily seen to be composed of a cellular to hymeniform layer of more or less isodiametric cells, veil never adherent and masking the pileal surface, pilocystidia and caulocystidia may be present .... E

B. Universal veil of mostly unbranched nondiverticulate cylindrical hyphae with no sphaerocysts present C

B. Universal veil often with few to many sphaerocysts present or if composed entirely of cylindrical hyphal elements these are either diverticulate and often branched or with nonswollen, thick-walled, clamped elements or with somewhat swollen, often thick-walled, nonclamped elements .... Section Picacei (p. 353)

C. Universal veil elements mostly abundant and either loose from the first or becoming loose as pileus matures, any veil remnants on stipe base white in color .... D

C. Universal veil elements scarce and adherent to pileal surface and difficult to remove, some brown veil remnants on stipe base below a flaring annular zone ..... Section Atramentarii (p. 352)

D. Species with a conspicuous annulus or volva, rarely with pleurocystidia ... . Section Coprinus (p. 351)

D. Species with no annulus or only an annular line or fringe marking the position of the unexpanded pileal margin on the stipe, pleurocystidia present .... Section Lanatuli (p. 351)

E. Pilocystidia present generally on entire pileal surface or occasionally restricted to a marginal fringe on the edge of the pileus .... Section Setulosi (p. 354)

E. Pilocystidia not present .... F

F. Universal veil present, species medium-small to large in size, pileus (1.5-) 2.5-48.0 mm in breadth .... Section Micacei (p. 355)

F. Universal veil not present, species small to medium in size, pileus 1.0-32.0 mm in breadth ...... Section Hemerobii (p. 356)

SECTION COPRINUS

Coprinus Pers. per S. F. Gray, Section Coprinus
= Comati Fr. (1838) em. Lange, Dansk. Bot. Ark. Bd. 2 No. 3, p. 36. 1915.
= Pelliculosi (Fr. 1838 ut tribus) em. Schröter, Pilze, p. 521. 1889.

Pileal surface outside of the apical disk composed of radially oriented hyphae, covered with and sometimes obscured by a universal veil of fibrils, often until late maturity. No sphaerocysts in the universal veil. No erect pilocystidia or caulocystidia, and usually no pleurocystidia. Definite annulus present, either free or attached to the base of the stipe like a volva and not reduced to a small bulge or flange. Stipe lumen generally with a yarn-like or weblike mass of loose hyphae. Sporocarp of medium to very large size and always undergoing autodigestion. Spores usually large, 10-25 µm in length, smooth walled. Species growing on dung or soil, rarely on wood, especially in disturbed areas.

TYPE SPECIES: Coprinus comatus O. F. Müller per S. F. Gray, Nat. Arrang. Brit. Pl. 1:632. 1821.

Observations: The distinguishing characters of section Coprinus are the pileal surface of radially oriented hyphae, the universal veil of mostly unbranched nondiverticulate hyphae with no sphaerocysts present, the abundance and loose nature of the veil when mature, the conspicuous annulus or volva and the lack of pleurocystidia in most species.

SECTION LANATULI

Coprinus Pers. per S. F. Gray, Section Lanatuli Fr., Epicrisis, p. 250. 1838.

Pileal surface except for the apical disk usually composed of radially oriented hyphae or radially elongated cells, at first covered very loosely with scales of universal veil composed mostly of parallelly oriented hyphae. Individual cells of scale hyphae often long and swollen, constricted at the septations, not branched, somewhat catenulate in appearance. Universal veil completely devoid of sphaerocysts. No erect pilocystidia or caulocystidia present. Large characteristic pleurocystidia present. Stipe without annulus, but sometimes with an annular line or small flange near the base where contacted by the margin of the unexpanded pileus. Sporocarps very variable in size, from minute to rather large. Spores less than 15 µm long, smooth walled or with an inflatable perisporium. Growing on dung, soil, decaying wood, or on charcoal.

TYPE SPECIES: Coprinus cinereus Schaeff. per S. F. Gray, Nat. Arr. Brit. Plants, p. 634. 1821.

Observations: The species of section Lanatuli found in western North America seem to fall into two general categories, one with globose to subglobose spores, and one with ellipsoidal spores.

SECTION ATRAMENTARII

Coprinus Pers. per S. F. Gray, Section Atramentarii Fr. Epicrisis, p. 243. 1838.

True pileal surface outside of the apical disk composed of radially oriented, slender, cylindrical hyphae, at least near the apex with small, appressed and usually colored, brown, red-brown or yellow-brown scales of fibrils, more or less parallelly aligned to themselves but not necessarily parallel to the radial pileal surface hyphae. These scales and fibrils often become confused with the epicutis in age so the pileus appears glabrous macroscopically. Universal veil devoid of sphaerocysts; both pilocystidia and caulocystidia absent. Many large and characteristic pleurocystidia present which act as mechanical braces to separate adjacent lamellae physically. No true annulus present; however, there is present an annular line or flange, composed of slender, anastomosed, interwoven, septate, occasionally clamped, hyaline to yellow hyphae, marking the early position of the pileal margin against the stipe. The filaments of the annular zone are the same as those forming the scales of the pileus and base of the stipe and often contain similar amorphous contents in some of the cells. Colored appressed scales like those at the pileal apex are often present on the stipe below the annular line or flange. Spores usually less than 12 µm in length and occasionally with distinct ornamentation. Species of medium to large size and growing near trees and on disturbed soils, never coprophilous.

TYPE SPECIES: Coprinus atramentarius (Bull. per Fr.)
Fr. Epicrisis, p. 243. 1838.

Observations: The universal veil of the species of section Atramentarii seems to be unique. It is composed of mostly very slender, thin walled hyphae that usually contain a yellow to yellow-brown amorphous substance. With age or exposure, the walls of most of the veil hyphae seem to lyse, leaving this amorphous content behind as the only visual evidence of the veil. Sometimes the individual strands seem to merge into broad filaments and patches which form the colored scales of the stipe and pileus.

SECTION PICACEI

Coprinus Pers. per S. F. Gray, Section Picacei Fr.,
Epicrisis, p. 244. 1838. (as subtribe), emend.
Van De Bogart.
Synonyms: Subtribe Picacei loc. cit.
Section Impexi Romagn. in Kühn. & Romagn.,
Fl. Anal., p. 386. 1953.
Section Vestiti (J. Lange) Kühn. & Romagn.,
Fl. Anal., p. 384. 1953, emend.

Pileal surface outside the apical disk composed either of radially oriented cylindrical hyphae or of cells distinctly elongate in a radial direction. Universal veil usually abundant, composed of some type of cylindrical hyphae, or sphaerocysts, or a combination of both. Universal veil elements mostly thin walled but in some taxa some or all elements thick walled, hyaline or pale, smooth or occasionally with acid-soluble or acid-insoluble incrustations and wall thickenings or with small to large diverticulations of the cell walls. Some species also with irregularly shaped cells present in the universal veil. The veil may have a woolly or mealy appearance in young specimens and may form a cortina. Other annulus types present only rarely. Spores variable in size and shape, a dislodgable perisporium often present. Spore wall somewhat thickened but seldom up to 2.0 µm thick. Clamp connections present or not. Cheilocystidia present and sometimes fused into a membranelike structure uniting adjacent lamellae when pileus is immature. Pleurocystidia present or not. Pilocystidia and caulocystidia absent. Sporocarps small to large. Species growing on dung, decaying plant debris, paper, wood, soil and charcoal.

TYPE SPECIES: *Coprinus picaceus* S. F. Gray, Nat. Arrang. Brit. Pl., 1:634. 1821.

Observations: The former sections *Picacei* (Romagnesi's *Impexi*) and *Vestiti* have been combined here for two reasons. The primary reason is that the presence of a pileal surface of radially oriented hyphae in *Picacei* and a hymeniform or cellular surface in *Vestiti* is in fact not valid. Species in *Vestiti* do not really have a cellular pileal surface. Careful examination of collections that were referable to section *Vestiti* showed that all except *Coprinus poliomallus* have a true pileal surface of radially oriented hyphae. This surface is sometimes overlain by a loose friable layer of sphaerocysts but not by a layer of isodiametric cells whose side walls are fused. The second reason is that certain features such as the spores and universal veil elements of species formerly assigned to one or the other section are very much alike. Often the general appearance of such species is also similar. With no real difference in pileal surfaces the only other difference becomes presence or absence of sphaerocysts in the universal veil. Even this criterion is not absolute. One collection of *Coprinus filamentifer* (FVDB 275) of Section *Picacei* shows the ends of some of its typical cylindrical veil hyphae as small diverticulated swellings that resemble the smallest sphaerocysts found in stirps Stercorarius (formerly comprising the bulk of Section *Vestiti*).

Coprinus poliomallus, which does have a good cellular pileal surface, has been placed in Section *Micacei* in view of its pileal surface and the nature of its spores and universal veil. The author of the species, Romagnesi, reports that the pileal surface cells are somewhat radially oriented in his material. The surface cells of my material are isodiametric and the taxon has been placed in *Micacei*. *C. poliomallus* seems to be transitional between Section *Micacei* and one group of species of Section *Picacei*.

SECTION *SETULOSI*

Coprinus Pers. per S. F. Gray, Section *Setulosi* (J.

Lange) Van De Bogart, stat. nov. et emend.
Basionym: Setulosi J. Lange ut subsectio Dansk.
Bot. Ark. 2(3):32. 1915.

Pileal surface of the cellular-hymeniform type, always distinct. Universal veil, if present, composed of sphaerocysts and occasionally with elongated and branched hyphae. Pileal surface characteristically with numerous pilocystidia often of several distinct types, including sclerocystidia. Pilocystidia occasionally restricted to the pileal margin as a fringe. No partial veil. Spore size variable, 6.5-20.0 μm in length, depending on species. Inflatable perisporal sac present or not. Caulocystidia often present. Cheilocystidia often variable in shape. Pleurocystidia present or not. Clamp connections present or not. Species growing on dung, soil, charcoal, dead leaves and debris, or on wood.

TYPE SPECIES: Coprinus congregatus Bull. per Fr., Epicrisis, p. 249, ss M. Lange.

Observations: This section was first presented by J. Lange (1915) as subsection Setulosi of his Section Nudi. The subsection contained all species with pilocystidia and no universal veil. Since there are numerous species with a universal veil that have both the cellular pileal surface and pilocystidia of Lange's subsection, I have chosen to include such species with those lacking a universal veil and raise the group to the level of section.

SECTION MICACEI

Coprinus Pers. per S. F. Gray, Section Micacei Fr., Epicrisis, p. 247. 1838. emend. Kühn. & Romagn., Fl. Anal., p. 382. 1953.

Pileal surface of the cellular-hymeniform type and only obscured by velar elements while small primordia. Universal veil present as sphaerocysts, or as chains of ellipsoidal cells, or as cylindrical to mixed cylindrical and swollen or somewhat irregularly shaped hyphae, always distinct from the pileal surface. No pilocystidia present, even on the pileal margin. Caulocystidia and pleurocystidia present or not. Cheilocystidia present, although rare in one species. Clamp connections present or not. Certain species give a transitory rose-lilac color reaction to 10% aqua ammonia when fresh. Spore length variable between species, 6.2-16.5 µm. Sporocarps medium-small to large in size, growing on wood, soil, plant debris, and rarely on manured soil or dung.

TYPE SPECIES: Coprinus micaceus (Bull. per Fr.) Fr., Epicrisis, p. 247. 1838.

Observations: The species of this section are mostly very similar in stature, habitat, and universal veil characteristics. They differ chiefly in overall pileal color, spore shape, cystidia, and in the presence or absence of clamp connections.

SECTION HEMEROBII

Coprinus Pers. per S. F. Gray, Section Hemerobii Fr., Epicrisis, p. 253. 1838.

Pileal surface of cellular-hymeniform type. Universal veil absent. Partial veil absent. Sporocarp completely glabrous and devoid of pilocystidia. Caulocystidia rarely present. Small to medium sized species resembling a parasol as they expand, very membranous and pleated or furrowed like an umbrella. Some species tardily autolytic. Spores medium sized, cordate, triangular, ovate, or elliptical, flattened or nearly round in cross section, 7.0-15.0 µm long. Species growing on dung, soil, and rarely on bark.

TYPE SPECIES: Coprinus hemerobius Fr., Epicrisis, p. 253. 1838.

Observations: One group of species in this section has cordate or triangular flattened spores and seems to form a natural and close-knit series. The other group of species bear a strong resemblance to species of Sections Setulosi and Micacei and in reality resemble the species with cordate to triangular spores only in possessing the same kind of pileal surface and in the mutual lack of universal veil and pilocystidia. There is a very real possibility that collections which are depauperate or heavily rain washed might be placed in Section Hemerobii when they should be placed in one of the other two sections with a cellular-hymeniform pileal surface.

Literature Cited

1. Kühner, R. & H. Romagnesi. 1953. Flore Analytique des Champignons Superieurs, Masson et C^{ie}, Paris. 556 p.

2. Van De Bogart, F. 1976. The Genus COPRINUS in Western North America, Part I: Section COPRINUS. MYCOTAXON 4(1):233-275

3. ______________ . 1979. The Genus COPRINUS in Western North America, Part II: Section LANATULI. MYCOTAXON (in press).

INDEX TO FUNGUS AND LICHEN TAXA

This index includes all taxa. The pages where all taxa are described or discussed are underlined. New taxa are in CAPITALS. The page numbers of all illustrations and line drawings are in parentheses ( ).

Acrocordia 34
Agalospora 19; anomia 20; irregularis 20; ocellata 20; profusa 17, 19, 20, (24), 26, 28
Agaricaceae 251, 252
Agaricales 117, 298
Agaricus 118; tribe collybia part genuinae 118; oomphalariae 118; tribe collybiae section laevipedes 118, 119, 120; striaepedes 118; tephrophanae 119; vestipedes 118, 121; maculatus var. scorzonereus 214; abundans 161; asprellus 114, 115, 116; butyraceus 219; campestris 251, 252, 253, 254; carnosus 209; cirrbatus 193; dryophilus 228; extuberans 222; familia 158; laceratus 159; (Tricholoma) limonium 209; luteo-olivaceus 150; maculatus 207; maurus 45; myosurus 165; myriodophyllus 167; nitellinus 139, 222; racemosus 191; tuberosus 197
Aleurieae 321
Amanita rubescens 253; vaginata 253
Amanitaceae 253
Amphisphaeria papilla 34; pelorospora 34; striata 24
Amylascus (309), 317, 318, 325; herbertianus (309), 317
Aphyllophorales 51
Armillaria 119
Ascobolaceae 297, 318
ASCOSCLERODERMA 297, 312, 336
Asteromassaria 27
Asterostomella 21

Baeospora 117, 121, 124, 127, 128, 132, 159, 162, 164, 167, 190; conigena 167; familia 158; myosura 162, (163), 164, 165, (166), 167; myriodophylla 124, 162, (163), 164, 167, (168)
Balsamia (309), 322, 323; alba (309); vulgaris 323
BALSAMIACEAE 297, 322
Barssia 297, 322; oregonensis 322; YEZO-MONTANA 297, 323, 336
Boletus gilvus 65; huronensis 105; pini 70; pomaceus 72

Carbomyces (311), 330; emergens (311), 330; longii (311)
Carbomycetaceae 297, 330
Caryospora 17, 19, 21, 32, 35
Callistosporium 117, 121, 124, 125, 126, 128, 129, 131, 147, 148; GRAMINICOLOR 148, 150, (151), 152; luteo-olivaceum 148, (149), 150, (151); palmarum 147
Calvatia 253
Cantharellaceae 252
Cantharellula subgenus neocantharellula 157
Cantharellus lateritius 252, 254; tubaeformis 253
Caryospora cariosa 21; callicarpa 21, 22, (25), 34; langloisii 22, (25); minima 22, 23, (25); minor 21; putaminum 21, 22, 23, (25), 35; striata 22, 24, (25)
Caulocarpa 316
Caulorhiza 117, 125, 128, 129, 131, 154; umbonata 150, (151), 154, (155)
Choiromyces 297, (310), 326; ABORIGINUM 297, 320, 334, 335; alveolatus 301, (310); echinulatus (310); meandriformis 326; venosus

(310), 326
CHRYSOCONIA 239, 240; ORTHOSPORA 239, 240, 241
Cladosphaeria lantanae 29; pyri 29
Clavariaceae 253
Clavulina cristata 253
Clavulinaceae 253
Clavulinopsis fusiformis 253
CLELANDIA 297, 317, 331; ARENACEAE 297, 316, 331
Clitocybe 39, 119, 123, 132, 134, 161; asterospora 43; clavipes 254; striatula 42
Clitocybula 117, 121, 124, 127, 131, 157; abundans 158, 161; familia 157, 158 159, 162, (163); lacerata 158, 159, 162, (163)
Clitopilopsis 134
Collybia 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 128, 132, 134, 147, 162, 170, 175, 187, 228; section conigenae 119; section cystidiatae 121; section dictyoplocae 120; section iocephalae 120; section nitellinae 119; section stripedes 120; butyracea stirps 120, 218; fusipes stirps 120; maculata stirps 120; section subfumosae 121; abundans 161; acervata 122, 159; albidula 38; albipilata 183; badiialba 226; butyracea 122, 219; cirrhata 193, 194; cirrbata var. cookei 194; colorea 150; conigena 122; cookei 194; cystidiosa 344; dryophila 129, 254; erosa 136; extuberans 222; familia 158; fuliginata 122; fusipes 202; lacerata 122, 160; lenta 122, lilacea 167; longipes 122; luteo-olivacea 150; maculata 122, 202, 209; var. occidentalis 217; var. scorzonerea 214; var. typica 210; mucida 122; myosura 165; myriodophylla 167; nitellina 138, 139; olympiana 136, 137; oregonensis 202, 204; platyphylla 122; ssp. lacerata 160; polyphylla 126; racemosa 124, 191; colorea var. rubescentifolia 152; sublatericia 139; subnuda 254; subsulcatipes 201, 202; teleoianthina 167; tenacella 122; trullisata 179; tuberosa 122, 124, 197; tylicolor 136; umbonata 154; velutipes 119
Collybidium 170
Coprinaceae 254
Coprinus 348, 349, 350, 351; section atramentarii 349, 350, 352, 353; section comati 351; section coprinus 349, 350, 351; section hemerobii 349, 350, 356; section impexi 349, 353, 354; section lanatuli 349, 350, 351, 352; section micacei 349, 351, 354, 355, 356; section nudi 355; section pelliculosi 351; section picacei 349, 350, 353, 354; section setulosi 349, 350, 354, 355, 356; section vestiti 349, 353, 354; subsection setulosi 355; subtribe picacei 353; atramentarius 353; cinereus 352; comatus 351; congregatus 355; filamentifer 354; hemerobius 356; micaceus 254, 356; picaceus 354; poliomallus 354
Coriolus biformis 252; versicolor 252
Corticiaceae 253
Cortinarius 4; paleaceus 45
Crinipellis 120
Cryptoderma yamanoi 70
Cystispora leucosperma 19
Cystoderma 341

Daedalia pini 70
Delastria 327, 328; rosea 328
Delastriopsis phlebodermum 297, 337
Densocarpa 320
Diatrype angulare 26, 27
DINGLEYA 297, (309), 317, 318, 331, (333); VERRUCOSA 297, (309), 314, 331, (333)

Dothivalsaria 19, 26; megalospora 17, (25), 26

Elaphomyces 297, 312; cyanosporus 312; granulatus 312; muricatus 312
Elaphomycetaceae 299, 312, 330
ELAPHOMYCETALES 297, 299, 312, 330
Elderia 320, 335
Entoloma 252
Entolomataceae 252

Fayodia 38, 39, 43, 120; subgenus clitocybula 157; abundans 161; ALUTACEA 39, (40), 46; anthracobia 38; bisphaerigera 38; campanella 38; deusta 38; familia 158; gracilipes 38, 39, 41, 43; lacerata 160; leucophylla 45; maura 38, 39; pseudoclusilis 38; striatula 38, 39, 42, 43; tenuisperma 38; tetrasphaerigera 38; xerophila 38
Flammulina 117, 119, 120, 124, 125, 127, 128, 132, 170; velutipes 129, 170, (171), 172, (173), 255
Filoboletus 232; gracilis 232, 237; banedai 232; luteus 232; manipularis 232; mycenoides 232; propullans 232, 233, 236, (236); staudtii 232
Fischerula (309), 315; macrospora (309), 315
Fomes 51; arctostaphyli 55, 67; badius 57; conchatus 58; everhartii 60; igniarius 67, 83; nigrolimitatus 69; occidentalis 70; pini 70; pini abietinus 72; pomaceus 72; putearius 69, 74; repandus 74; ribis 74; robineae 76; robustus 77; tenuis 85; tarulosus 81; igniarius f. tremulae; robustus var. tsugina 67; viticola 85; weirianus 85
Fomitoporia prunicola 73; weirii 87

Genabea (310), 324, 325; fragilis (310), 327
Genea 297, (310), 324, 325; arenaria (310); compacta (309); gardneri (310); KRASPEDOSTOMA 297, 322, 336; verrucosa 324
GENEACEAE 297, 319, 324, 330
Geopora 298, 319; cooperi 319
Geopyxidaceae 321
Geopyxis 321
Gloeoporus dichrous 253
Gomphaceae 252
Grifola frondosa 251
Gymnopus 147; albipilatus 183; badiialbus 226; butyraceus 219; carnosus 209; denticulatus 158; familia 158; sublatericius 139; truillisatus 179

Halocyphina 49
Hebeloma 138
Helvella astieri 313
HELVELLACEAE 297, 313, 324, 325
Hemicollybia 132
Hericium ramosum 252, 254
Heterosporula 38
Hirneola 134
Hirschioporus pargamenus 253
Hydnobolites (310), 326, 327; californicus 327; cerebriformis (310), 327
Hydnocystis 319; japonica 319; piligera 319
Hydnotrya (309), 314, 315; cerebriformis (309); ellipsospora 297, 314, 316, 336; michaelis 314; tulasnei (309), 314; variiformis (309); yukonensis 314
Hydnotryopsis (309), 317, 318; compacta (309); setchellii 317
Hygrophoraceae 252
Hygrophorus borealis 253; pratensis 252
Hymenochaetaceae 51
Hymenomycetes 51
Hypholoma capnoides 254
Hypocreaceae 252
Hypomyces lactifluorum 252
Hypsizgus marmoreus 253

Inocybe 4, 46

Inonotus glomeratus 63
Ischnoderma resinosum 253

Jaapia 241
Julella luzonensis 32

Labyrinthomyces 297, (309), 320; donkii 321; steenisii 318; VARIUS 297, (309), 320, 336
Laccaria ochropurpurea 254
Lactarius chrysorheus 252; deceptivus 252; gerardii 252; vellereus 252
Lactocollybia 121
Laetiporus sulphureus 254
Lepista 43, 135, 136
Leptomitales 90
Leptonia asprella 114, 115, 116; inocybeoides 116
Leptosphaeria 24; tumefaciens 24
Leptosphaerulina 20
Lespiaultinia 328, 329
Limnoperdon 48, 49, 50; incarnatum 48, (49)
Lophiostoma macrosporum 33
Lycoperdaceae 253
Lyophyllum 117, 119, 120, 124, 125, 126, 127, 128, 131, 132, 136, 138; section difformia 133; section lyophyllum 134; section nigrescentes 125; section tephrophana 133; ambustum 127; leucophaeatum 132; palustre 134

Marasmius 119, 123, 124, 164, 175, 190, 341, 343; section globulares 343; section sicci 343; stirps cohaerens 341, 342, 343; cohaerens 342, 343, (347); cystidiosus 342, 343, 344, 345; delectans 343, (347); fasciatus 343; LEIGHII 343, 344, (346); oreades 254
Massaria 17, 19, 20, 27, 30, 32; anomia 20; epileuca 30; gigaspora 28, 29; inquinans 27, 28, 29, (31); forma pyri 29; forma viburna 29; lantanae 28, 29, (31); plumigera 29; var. tetraspora 29; profusa 20; pruni 29; pyri 28, 29, (31); seiridia 20; vomitoria 28; xanthoxyli 27, 28, 29, 30, (31)
Massariaceae 17, 18
Massariella xanthoxyli 30
Massariovalsa megalospora 26; sudans 26
Melanoleuca 43
Melanommataceae 21
Melanommatales 18
Melanomma sulcata 24
Merulius tremellosus 253
MICROCOLLYBIA 117, 121, 124, 125, 126, 127, 132, 187, 190; CIRRATA 188, (189), 190, (192), 193, 196, 198; COOKEI 188, (189), 190, 194, (195), 196; RACEMOSA 188, (189), 190, 191, (192); TUBEROSA 187, 188, (189), 190, (195), 196
Mucidula 119
Mucronoporus everhartii 60
Mukagomyces 328, 329; miromichii 297, 336
Mycena 119, 124, 174, 175; cineraria 42, 43; myriodophylla 167; serotina 254
Mycenella 43
Mycolachneae 319, 320, 321
Myrmaecium megalosporum 26
Myxocollybia 120, 170
Myxomphalia 38, 43; maura (44), 45, 46

Omphaliaster 43
Omphalina striatula 42
Oömycetes 90
Ostreichnion americanum 33; sassafras 33
Otideoideae 319
Oudemansiella 117, 119, 120; radicata 156, 254, 255

Pachyphloeus (310), 326, 327; citrinus (310); conglomeratus (310); melanoxanthus 326
Panellus serotinus 253; stypticus 253, 255
Paradoxa (311), 328, 329, 330; monospora (311), 329
Parmentaria astroidea 27
Paurocotylis 321; pila 321
Peltigera 42

Perenniporia subacida 254
Petchiomyces 321; kraspedostoma 297, 322, 336; thwaitesii 321
Peziza 297, (309), 316, 317, 318; ELLIPSOSPORA 297, (309), 314, 316, 336; jactata 316; STUNTZII 297, 316, 335; vesiculosa 316; whitei 316
PEZIZACEAE 297, 315, 316, 318, 319
Pizazales 297, 298, 299, 313, 324, 336
Phaeocollybia kauffmannii 156
Phellinus 51, 52, 63, 70, 87, 88; arctostaphyli 53, 55, (56); badius 52, 53, (56), 57, 76, 89; chrysoloma 53, (56), 57, 58, 70, 72; conchatus 53, 58, (59), 60; everhartii 52, 53, (59), 60, 87; ferreus 52, 53, 60, (61), 62, 63; ferrugineofuscus 52, 53, (61), 62, 63, 70, 87; ferruginosus 52, 53, 62, 63, (64); gilvus 53, (64), 65, 81; hartigii 53, 65, (66), 67, 74, 77; igniarius 53, 55, (66), 67, 69, 73, 83; laevigatus 53, 67, (68), 69, 73; nigrolimitatus 52, 53, (68), 69, 74, 81; occidentalis 52, 53, 60, 70, (71), 72; pini 53, 58, 60, 70, (71), 72; pomaceus 53, 67, 72, 73, (75); prunicola 51, 53, 73, (75); punctatus 53, 73, (75), 77; repandus 53, 74, (75); ribis 52, 53, 74, (75), 76; rimosus 89; robineae 52, 53, 57, (75), 76; robustus 53, 73, (75), 77, 79, 81; SONORAE 51, 53, 77, (78), 79; texanus 53, 79, (80), 81; torulosus 52, 53, 65, 81, (82); tremulae 53, 67, (82), 83; viticola 52, 53, 83, (84), 85; weirianus 52, 53, 60, (84), 85, 87; weirii 51, 52, 53, 63, 70, (86), 87
Pholiota lenta 254; squarrosoides 254
Phoma 27
Phylloporia 76
Phymatomyces 322; yezomontana 297, 323, 336
Picoa 322, 323, 324, 325; juniperi 323
Piersonia 301
Platystomum macrosporum 33
Pleamphisphaeria 30, 32; luzonensis 32
Pleospora 32
Pleuropus roseiavellaneous 140
Pleurotus ostreatus 253
Pluteospora 134
Polyporaceae 51, 251, 252
Polyporus badius 57; chrysoloma 57; conchatus 58; ferreus 60; ferruginosus 63; gilvus 65; hartigii 65; igniarius 67; laevigatus 67; nigrolimitatus 69; punctatus 73; ribis 74; torulosus 81
Poria 51; albipellucida 63; ferrea 62; ferrugineofusca 62; ferruginosus 63; isabellina 85; prunicola 73; punctata 73; tsugina 67, 73; weirii 87
Poromycena 232
Pseudobalsamia 323
Pseudohiatula 121, 174
Pseudohydnum gelatinosum 255
Pseudovalsa profusa 20; irregularis 20
Pseudovalsaria occulta 29
Pyrenophora 20
PYRONEMATACEAE 297, 319, 321, 325
Pyropolyporus robineae 76; texanus 79
Pythium 90

Ramaria botrytis 254; flavobrunnescens var. aromatica 252
Rhodoarrhenia 49; pezizoides 49
Rhodocollybia 117, 123, 124, 127, 128, 129, 132, 198; section butyracea 200, 218; section maculata 200; badiialba 219, 222, (223), 224, (227); BUTYRACEA 218, 219, (220), 221, 222, (223); extuberans 218, 222, (223), 224, 225, 228;

maculata 198, 205; var. FULVA 201, 212, (213); var. IMMUTABILIS 201, 215; var. maculata 200, 202, (203), (206), 207, (208_, 210, 218; var. NIGRA 201, (208), 211, 212, (213); var. occidentalis 201, 212, (213), (216), 217; var. SCORZONEREA 201, 214, (216); OREGONENSIS 126, 200, 202, (203), 205, (206); SUBNIGRA 201, 205, 212, (213); SUBSULCATIPES 200, 201, 202, (203)

Rhodocybe 43, 117, 120, 125, 127, 128, 129, 134, 135, 136, 138, 143, 144; section echinosporae 136; section nitellinae 135, 136, 138; section rhodocybe 128, 131, 136, 145; aureicystidiata 128, 140, (141), (142), 145, (146), 147; caelata 134, 145, 147; nitellina 126, 138, 139, 140, (141), (142); olympiana 127, 137, (142); roseiavellanea 138, 140, (141), (142); speciosa 138, 140, (141), (142), 143; striatula 42, 43

Rhodopaxillus nitellinus 139

Rhodophyllus 135

Russula 43, 93; section emeticinae 99; section polychromae 97; section viridantinae subsection polychromae 97; albella 101; albida 99; albidula 99; albiduliformis 101; alutacea 252; anomala 99; cicatricata 97; crenulata 101; elaeodes 97; emetica 252; fragilis 252; furcata 97; heterophylla 97; var. chlora 97; innocura 101; maculosa 101; nigricans 252; pantoleuca 101; pectinatoides 252; rosacea 93, 103, 105; var. MACROPSEUDOCYSTIDIATA 93, 101, (104), 112, (113); rugulosa 252; sanguinea 103; STUNTZII 93, 97, 99, (100), 101, 110, (111); variata 252; VIRIDOFUSCA 93, 94, (96), 97, 108, (109); xerampelina 97

Russulaceae 252

Saccothecium 27

Sapromyces 90; androgynus 90

Sarcosphaera 316; crassa 316; macrocalyx 316

Scleroderma 313

Sphaeria amorphostoma 20; anomia 20; callicarpa 22; capitella 20; cyploxia 33; inquinans 28; papilla 34, 35; profusa 20; putaminum 23; sulcata 24

Sphaerosoma 318; fuscescens 318

Sphaerozone 322; ostiolatum 322; tulasnei 322

Splanchnonema 27

STACHYOMPHALINA 39, 40; STRIATULA 41, 42, 43, (44), 45

Stephensia 320, 335; arenivaga 320, 335; bombycina 320; varius 297, 320, 321, 336

Strobilurus 117, 121, 124, 125, 126, 127, 128, 129, 132, 164, 174, 175, 176, 190; albipilatus 176, 180, (181), 183, (185), (186), 187; conigenoides 174; lignitilis 176, 180, (181), 182, 183, 184, 187; occidentalis 176, 180, (181), 182, 187; TRULLISATUS 172, (173), 176, (177), (178), 179, 183

Stropharia ambigua 254

Strophariaceae 254

Suillus 285; acerbus 293; albidipes 294; albivelatus 289; anomalus 286, 290; appendiculatus 288; borealis 294; brevipes 295; brunnescens 291; caerulescens 286, 287; californicus 293; cavipes 287; flavogranulatus 291; fuscotomentosus 293; glandulosipes 294; granulatus 296; grevillei 288; helenae 290; imitatus 286, 287; kaibabensis 296; lakei 286, 287; lithocarpi-sequoiae 288; luteus 291; megaporinus 289; monticolus 295; occidentalis 295; pallidiceps 295; ponderosus 286, 287; pseudobrevipes 291; punctatipes 289; pungens 293; reparius 289; reticulatus 294; ruber 292; sibiricus 290; subolivaceus 291; subvariegatus 292; tomentosus 292; umbonatus 290; volcanilis 293; wasatchicus 294

Teichospora 32
Terfezia (310), 324, 325, 326, 327, 328; arenaria (310), 327; claveryi (310); leonis 327; longii (310); oligospermum 297, 336;
TERFEZIACEAE 297, 318, 324, 325, 329
Trimania (309), 318, 325; africana 321; nivea 318; pinoyi (309)
Titanella 17, 18, 30, 31, 32, 33; luzonensis (31), 32; macrospora (31), 32, 33, 34; pleorospora (31), 32, 34
Trametes isabellina 85; pini 70; setosus 85
Trematosphaeria 21, 27; callicarpa 34; epileuca 30; striata 24
Tremellaceae 255
Tricholoma 119, 123, 132, 138, 161; resplendens 253; sejunctum 253
Tricholomataceae 117, 253, 341
Trichophaea 319
Tuber 297, (311), 315, 328, 329, 330; aestivum (311); besseyi (311); brumale (311), 328; cibarium 328; HIROMICHII 297, 336; OLIGOSPERMUM 297, 336; PHLEBODERMUM 297, 337; shearii (311)
TUBERACEAE 297, 328
Tuberales 297, 298, 299
Tulostoma 277; campestre 280; ferrugineum 277, 279, (282); fibrillosum 281; jourdani 281; poculatum 281; simulans 281; striatum 283; stuntzii 277, 278, (282); tuberculatum 283; verrucosum 283
Tyromyces caesius 254; fragilis 254

Valsa profusa 20
Valsaria angularis 26; megalospora 26

Wettsteinina 20

Xerula 120

Zopfia 17, 18, 35; albiziae 35; rhizophila (31), 35
Zopfiaceae 18

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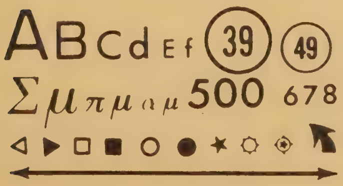

MYCOTAXON

Volume IX June 12, 1979 No. 1

A FESTSCHRIFT IN HONOR OF DANIEL E. STUNTZ

CONTENTS

Contents.. 1
Preface... 2
Daniel E. Stuntz - A distinguished professor and friend. DAVID RAMON HOSFORD 3
On the Massariaceae in North America............ MARGARET E. BARR 17
Notes on *Fayodia* ss. lato...................... HOWARD E. BIGELOW 38
Limnoperdon, a cyphellaceous fungus with gasteroid basidia? GUSTAVO A. ESCOBAR AND DENNIS E. MCCABE 48
The genus *Phellinus* (Aphyllophorales: Hymenochaetaceae) in western North America........................ R. L. GILBERTSON 51
Synaptonemal complexes in the gametangia of *Sapromyces androgynus* (Leptomitales, Oomycetes)............. DAVID GOTELLI 90
New and interesting taxa of *Russula* Pers. *ex* S.F. Gray occurring in Washington State.................. DARRYL W. GRUND 93
Neotype selection for *Agaricus asprellus* Fr. .... DAVID L. LARGENT 114
Collybioid genera in the Pacific Northwest. JOANNE WILLIAMS LENNOX 117
Filoboletus propullans, a new poroid agaric from Panamá. SUSAN D. LIBONATI-BARNES 232
Chrysoconia, a gasteroid member of the Coniophoraceae. DENNIS E. MCCABE AND GUSTAVO A. ESCOBAR 239
The contributors and Daniel Stuntz.............. DAVID L. LARGENT 243
Laccase and tyrosinase oxidation of spot test reagents. CURRIE D. MARR 244
Two new species and new records of *Tulostoma* from the Pacific Northwest................ DENNIS M. OLIVER AND DAVID R. HOSFORD 277
The genus *Suillus* in the western United States.... HARRY D. THIERS 285
The orders, families and genera of hypogeous Ascomycotina (truffles and their relatives)................. JAMES M. TRAPPE 297
The stirps *Cohaerens* of *Marasmius*............. ALEXANDER H. SMITH 341
The sections of *Coprinus* present in the western United States. FRED VAN DE BOGART 348
Index to Fungus and Lichen Taxa.................................. 358

Guest Editor: DAVID L. LARGENT

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[MYCOTAXON for April-June 1979 (8: 321-572)
was issued April 21, 1979]

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MYCOTAXON

AN INTERNATIONAL JOURNAL DESIGNED TO EXPEDITE PUBLICATION
OF RESEARCH ON TAXONOMY & NOMENCLATURE OF FUNGI & LICHENS

Volume IX July-September 1979 No. 2

CONTENTS

A monographic revision of the genus *Sclerotinia*.... LINDA M. KOHN 365
Hypogeous ascomycetes in Alberta, Canada with two new North American records............................... R. M. DANIELSON 445
Hypogeous fungi of Minnesota: *Genea anthracina* sp. nov. ELWIN L. STEWART AND RUSSELL K. HEBLACK 451
Notes on mycological history. I. M.A. Curtis vs. a national herbarium.................................. RONALD H. PETERSEN 459
A new combination in the genus *Flagelloscypha* and a contribution to the identity of *Cyphella peckii*.................. R. AGERER 464
Notes on hyphomycetes. XXXII. Five new aquatic species. R. C. SINCLAIR AND G. MORGAN-JONES 469
Urédinales nouvelles de l'Himalaya.................. GUY DURRIEU 482
Western fungi: a New Mexico *Psathyrella* in the *Cystidiosae* of subgenus *Homophron*...... W. W. PATRICK, JR. AND CHARLES BARROWS 493
Type studies in the genus *Peziza*. VIII-X. Species described by G. Massee, E.K. Cash, and F.J. Seaver........ DONALD H. PFISTER 501
Notes on Corticiaceae (Basidiomycetes) IV. KURT HJORTSTAM AND LEIF RYVARDEN 505
Notice: Mycological Nomenclature - Fossil Fungi.................. 520
Later starting point blues. I. *Monilia fructigena*. RICHARD P. KORF AND LINDA M. KOHN 521

Author INDEX.. 523
Errata, Volumes 7, 8 & 9.................................... 524
Reviewers... 524
MYCOTAXON publication dates, 8(2) and 9(1)...................... 524
INDEX to Fungous and Lichen Taxa............................... 525

[MYCOTAXON's special issue, the STUNTZ FESTSCHRIFT, (9: 1-364) was issued June 12, 1979]

ISSN 0093-4666 MYXNAE 9(2) 365-528 (1979)

Library of Congress Catalogue Card Number 74-7903

Published quarterly by MYCOTAXON, Ltd., P.O. Box 264, Ithaca NY 14850
For subscription details and availability in microform, see back cover

ALBERT R. MANN
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JUL 20 1979

MYCOTAXON

Vol. IX, No. 2. pp. 365-444 July-September 1979

A MONOGRAPHIC REVISION OF THE GENUS SCLEROTINIA

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SUMMARY

The genus *Sclerotinia* (Inoperculate Discomycetes) is redefined to include only those species producing tuberoid sclerotia not incorporating host tissue within the sclerotial medulla, developing an apothecial ectal excipulum composed of globose cells, and not producing a disseminative conidial state. Keys to the sclerotial-forming genera of the Sclerotiniaceae and to the species of *Sclerotinia* are provided. Three species are retained in the genus: *S. sclerotiorum, S. minor, S. trifoliorum.*

The taxonomy and nomenclature of 259 epithets previously referred to *Sclerotinia* are reviewed with 21 placed in synomymy under the 3 accepted species and 25 included as imperfectly known; 210 epithets are excluded and either assigned to other genera or accepted in other genera where they have been referred by other authors. Two new genera are erected: *Elliottinia,* to accommodate *S. kerneri,* and *Dumontinia,* to which *S. tuberosa* is transferred. *S. camelliae* Hansen & Thomas, a nomen nudum, is provided with a Latin diagnosis and placed in *Ciborinia.*

INTRODUCTION 366

MATERIALS AND METHODS 366

MORPHOLOGY 367

HISTORY AND DELIMITATION: TAXONOMY AND NOMENCLATURE 369

HABITAT 371

COMPARATIVE STUDIES IN CYTOLOGY, ELECTROPHORETIC ASSAYS, SCLEROTIAL ONTOGENY, AND MYCELIAL INTERACTIONS 371

CULTURAL STUDIES 372

GENERIC DIAGNOSIS 377

KEY TO THE SCLEROTIUM-FORMING GENERA OF THE SCLEROTINIACEAE 377

KEY TO THE SPECIES OF SCLEROTINIA 378

ACCEPTED SPECIES: 1. S. SCLEROTIORUM 378

2. S. MINOR 384

3. S. TRIFOLIORUM 387

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[1] At present the Anna E. Jenkins Postdoctoral Fellow of the Herbarium.

TAXA IMPERFECTLY KNOWN 391
EXCLUDED TAXA AND SYNONYMS 395
ACKNOWLEDGEMENTS 437
LITERATURE CITED 437
INDEX TO HOSTS CITED IN THE TYPE DESCRIPTIONS 440
INDEX TO GENERA, SPECIES, AND INFRASPECIFIC TAXA 442

INTRODUCTION

In most of the larger genera of phytopathogenic fungi the necessity of naming and of recognizing variation has long been at odds with the need for simple systems of identification and diagnosis. Despite continued study by phytopathologists and taxonomists, the taxonomic delimitation and relationships of the plant pathogenic species of *Sclerotinia* have never been resolved. Over the years, using traditional morphological and host preference characters, over 250 taxa of diverse relationships, both pathogenic and nonpathogenic, have been assigned to *Sclerotinia*, with consequent controversy and confusion over generic and specific limits. In an effort to simplify identification, previous workers reevaluated several traditional characters and discarded them as being too variable; one result is that for the past twenty-five years several important plant pathogenic species were synonymized under the name *Sclerotinia sclerotiorum*. More recently, with increased information about the biology and epidemiology of these species and with reexamination in the light of microanatomical and cultural characters employed by contemporary discomycete taxonomists, it has become apparent that under this broad definition of *S. sclerotiorum* several taxa have been submerged under one species.

The redelimitation based on morphological and cultural characters of three closely related species provided in this paper should serve both as a framework for comparative study and as a useful system for identification. The emended generic concept is comparable to those delimiting other genera in the Sclerotiniaceae. A large group of species are either placed in synonymy or referred to other genera.

MATERIALS AND METHODS

Microscopic investigations in these studies were of both fresh collections where available and dried herbarium specimens, which were rehydrated in distilled water. Apothecia and sclerotia were sectioned on a freezing microtome at 15-20 μm and 5 μm respectively.

Observations were made in three mountants: Melzer's Reagent, methyl blue in lactic acid, and KOH-phloxine-glycerine, the formulations of which follow:

i. Melzer's Reagent: 0.5 gm iodine, 1.5 gm KI, 20 gm chloral hydrate, 20 ml distilled water.

ii. Methyl blue: 0.05 gm Williams 'Revector' stain, soluble blue 706, 30 gm lactic acid.
iii. KOH-phloxine-glycerine: Section placed in drop of 2% aq KOH; section transferred to a drop of 1% aq phloxine; section transferred to a drop of 50% slightly acidified aq glycerine; section transferred and mounted in 96% glycerine.

Measurements were made in Melzer's Reagent and methyl blue in lactic acid.

Studies of nuclei were made using the Giemsa staining technique outlined by Commonwealth Mycological Institute (1968).

Cultures were grown and maintained on DIFCO Potato Dextrose Agar. For information on the handling of cultures and the technique used to produce apothecia *in vitro* see Kohn (1979).

Photomicrographs were taken with a camera mounted on a Zeiss WL microscope. Drawings were made with the aid of a Wild drawing tube.

Microanatomical terms are those of Starbäck (1895), revised and defined by Korf (1952, 1973).

Herbarium abbreviations are those of Holmgren and Keuken (1974). Abbreviations of literature citations are from *Botanico-Periodicum-Huntianum* (Lawrence, et al. 1968) or are based on the style of abbreviation therein.

The sign (!!) indicates that holotype or isotype material has been examined; the sign (!), that syntype, paratype, or other authentic material has been examined.

In the synonymies of excluded taxa, names I am prepared to accept are in *ITALIC CAPITALS*.

Typical hosts, where indicated, are as reported in original descriptions; author citations are those of the describing author and where not indicated by the author, have not been included in this paper.

Several new combinations cited in this paper are formally made in another paper (Kohn, 1979, *Phytopathology*, *in press*). To avoid confusion in nomenclatural dating in the event that this paper is published first, use of these combinations in this paper is to be considered provisional pending formal publication in *Phytopathology*.

MORPHOLOGY

STROMA. The stroma is a food storage and survival organ composed of a hyaline hyphal medulla surrounded by a rind of cells with melanized walls. Whetzel (1945) recognized two types of stroma: the *substratal stroma*, an indeterminate stroma with a medulla of host tissue permeated by hyphae and with a thin black rind covering at least a portion of the stromatal surface, and the *sclerotial stroma*, a determinate stroma either developing within host tissues and incorporating remnants of these tissues within the medulla, or developing free from host tissues. The species of *Sclerotinia* possess a sclerotial stroma developing free from host tissues, not incorporating host tissues within the medulla, and often collected in the absence of identifiable host organ remnants.

The sclerotial medulla in *Sclerotinia* is composed of hyaline textura oblita with heavily gelatinized walls, 2-3 μm thick. The sclerotial rind is composed of the apices of these medullary cells which turn out perpendicularly to the sclerotial surface and become textura prismatica, with cells inflating to become globose and often somewhat disarticulated. Brown pigmentation of these rind cells occurs in the walls of a two- to six-deep layer of the outermost cells (Figs. 3e, 9f).

Sclerotia of *Sclerotinia* species develop abundantly in culture although the ability to produce sclerotia may be lost in old isolates. Under the conditions of these studies, sclerotia developed superficially above the surface of the agar on aerial mycelium.

MICROCONIDIA. As in the other genera of the Sclerotiniaceae, globose, hyaline microconidia are produced from flask-shaped phialidic conidiophores borne laterally on hyphae either singly or grouped in sporodochia (Fig. 9e). In *Sclerotinia* microconidia are produced superficially on aerial mycelium in culture, on the hymenial surface of apothecia (from germinating ascospores), and on the surface of sclerotia. Since the species of *Sclerotinia* are homothallic (Keay, 1939), the role of microconidia as functional spermatia is dubious. Evidence has been given for microconidia serving as germinable spores after overwintering in *Botrytis fabae* (Harrison & Hargreaves, 1977) but as yet no such role has been proven for species in *Sclerotinia*.

ASCOCARP. The apothecia are stipitate, cupulate and are produced from a sclerotium (Figs. 2, 6, 8b). Stipe primordia originate within the medulla of the sclerotium and eventually rupture the rind (Saito, 1977). Apothecia are 2-10 mm in diameter, cinnamon to umber and usually concolorous, though mottling and darkening at the margin are common. Some mealiness due to tomentum hyphae may be present on the surface of the receptacle and stipe.

The 8-spored asci are produced from vertically oriented repeating croziers (Figs. 3c, 7b). The asci are cylindrical, tapering down to the attachment to the crozier. The ascus walls are thin, 1 μm thick, and the apex is slightly thickened, 1-2 μm thick (Figs. 3a, 7d, 9c). Species in *Sclerotinia* show a bluing reaction of the ascus pore channel wall in Melzer's Reagent, termed J+. In one species this reaction is very weak but is enhanced with pretreatment in 2% KOH following the procedure of Kohn & Korf (1975).

The ascospores are hyaline and ellipsoid to somewhat flattened on one surface (Figs. 3b, 7c, 9b). In one species dimorphism in spore size has been observed, generally with a 4:4 segregation of small and large ascospores within the ascus (Fig. 8a). This phenomenon has been observed and illustrated by Woronin (1888) and Buchwald (1956) in *Monilinia* and by Sawada (1919) in *Ciborinia allii*. Ascospores are uniseriate in the ascus (Figs. 3d, 7a, 9d). Germination of ascospores may be bipolar or unipolar, with germination often occurring from the middle of the ascospore (Fig. 9a). In culture, ascospores often germinate while still within the ascus. Ascospores are biguttulate at maturity. Nuclear number within ascospores varies from 2-4 according to species as reported by Wong & Willetts (1979) and verified by my observations.

The paraphyses are filiform, sparsely septate and occasionally branched (Figs. 3d, 7a, 9d).

The subhymenium is a compact layer, usually bound in gel, of pale brown-walled textura intricata. This layer often blues in Melzer's Reagent. The medullary excipulum is composed of loosely interwoven textura intricata, usually hyaline and often incorporating rhomboidal crystals. The meduallary excipulum of the stipe may be of textura intricata or textura porrecta, sometimes bound in gel and often including rhomboidal crystals.

The ectal excipulum of the apothecium and stipe is composed of textura prismatica oriented perpendicularly to the apothecial surface, with the hyaline to pale brown-walled cells becoming inflated to globose and disarticulating somewhat. In one species, the margin of the apothecium is composed completely of globose cells (Fig. 5). In the other species, the margin is composed of textura porrecta parallel to the asci; further down the ectal excipulum, toward the flanks, the textura porrecta develops shorter cells oriented perpendicularly to the apothecial surface (Fig. 4). Gel may be present or absent in this layer (see Kohn, 1979) and bluing in Melzer's Reagent occurs occasionally in the presence of gel.

Tomentum hyphae, one to two cells in length, are often present as processes from the globose cells of the ectal excipulum of the apothecium, stipe, and sclerotium. These are usually hyaline to pale brown-walled on the apothecium and darker brown and often grouped in fascicles on the stipe. The presence or absence of tomentum appears to be rather variable (Kohn, 1979) but is of some use as a taxonomic character of the sclerotial rind (Fig. 9f).

HISTORY AND DELIMITATION: TAXONOMY AND NOMENCLATURE

The genus *Sclerotinia* was erected by Fuckel to accomodate *Sclerotinia candolleana, S. fuckeliana, S. libertiana* (an obligate synonym of *S. sclerotiorum* erected by Fuckel to avoid a supposed tautonym), *S. tuberosa,* and *S. baccata*. *S. baccata* was found to be an operculate discomycete and was synonymized by Rehm with *Sarcoscypha protracta* (Fr.) Sacc. Nannfeldt (1932) accepted *Sclerotinia* in the broad sense of Fuckel and synonymized *Stromatinia*, further expanding the generic concept.

In 1945 Whetzel redelimited the genus in a much more restricted sense to include only those species producing a true sclerotium not including host tissue, not producing a conidial state, and with hyaline spores. He transferred *S. fuckeliana* to his new genus *Botryotinia*, erected to accomodate those species producing a *Botrytis* conidial state, and transferred *S. candolleana* to *Ciborinia*, also a new genus, erected to include species in which remnants of host tissue are incorporated in the sclerotial medulla. Whetzel also accepted *Stromatinia* on the basis of the mantling sclerotium compared to the tuberoid sclerotium of *Sclerotinia*. In 1947 Buchwald segregated a group of species previously assigned to *Sclerotinia* developing sclerotia and *Myrioconium* microconidial states within the culms of species in the Juncaceae and Cyperaceae in a new genus, *Myriosclerotinia*. Many phytopathologists and some taxonomists (Dennis, 1956, 1978) accept *Sclerotinia* in the broad sense of Fuckel to include a large and diverse group of species. Some phytopathologists as yet choose to include *Monilinia* in their concept of the genus.

In addition to the development of a tuberoid sclerotium not incorporating host tissue, absence of a disseminative conidial state, and production of hyaline ascospores, I delim- the genus *Sclerotinia* in a yet more restricted sense to include only those species in which the ectal excipulum is composed of globose cells oriented perpendicularly (as textura prismatica with inflated cells) to the apothecial surface. *S. tuberosa*, considered congeneric with *S. sclerotiorum* by Korf & Dumont (1972), has an ectal excipulum composed of textura porrecta, usually embedded in a thick layer of gel, oriented parallel to the apothecial surface, and must, therefore, be transferred to a new genus, *Dumontinia*. I accept the genus *Myriosclerotinia* in the sense of Buchwald with the additional observation that species included in this genus usually possess a covering layer of textura porrecta over the ectal excipulum and have granularly roughened medullary hyphae, in addition to internal development within the host of sclerotia and the *Myrioconium* microconidial state.

This restricted generic concept of *Sclerotinia* has necessitated the exclusion or placement in synonymy of many epithets. While not a problem in species retained in the genus, the application of Article 59 of the International Code of Botanical Nomenclature concerning fungi with pleomorphic life cycles to some epithets previously assigned to *Sclerotinia* requires clarification. An epithet based on an anamorph (Hennebert & Weresub, 1977) and assigned to a teleomorphic genus indicates poor taxonomic judgment but is not invalid and preoccupies the combination even if someone later describes the teleomorph and applies the same name. When the teleomorph is discovered, it requires a new epithet if placed in the same teleomorphic genus; the same epithet may be used, with a new author's citation, in a different teleomorphic genus.

The typification of *Sclerotinia* has been a source of confusion for many years. In 1928 the genus was lectotypified by Honey with *S. candolleana*. Whetzel transferred *S. candolleana* to *Ciborinia* in 1945, and ignoring Honey's lectotypification, retypified his redelimited genus *Sclerotinia* with *S. sclerotiorum*. If one accepts Whetzel's restricted circumscription of genera in the Sclerotiniaceae, a taxonomic decision, then *Sclerotinia*, lectotypified by *S. candolleana*, becomes the oldest available name for *Ciborinia*. This was the position taken by Korf & Dumont (1972) in erecting *Whetzelinia*, typified by *S. sclerotiorum*. Because many workers, especially plant pathologists, accept both Whetzel's circumscription and his typification of *Sclerotinia* with *S. sclerotiorum*, a proposal to conserve *S. sclerotiorum* as the lectotype of *Sclerotinia* has been presented (Buchwald & Neergaard, 1976) and accepted by the Special Committee for Fungi and Lichens of the International Association of Plant Taxonomists (Peterson, 1978). It has received approval by the IAPT General Committee and only final action by the International Botanical Congress in 1981 is still pending.

HABITAT

For a review of the ecology of *Sclerotinia* species see Adams (1979). The history, geographical distribution, host range, economic importance and general symptomology have been recently reviewed by Purdy (1979).

The species of *Sclerotinia* are world-wide in distribution and are pathogenic on all parts of a wide range of herbaceous plants. Diseases caused by these species are of considerable economic importance. *S. sclerotiorum* has a reported host range of over 350 species in 60 families (Schwartz, 1974) including plants occurring as weeds. *S. minor* has a somewhat narrower host range including several families of economically important plants. While the two preceding species attack a broad range of plants, including forage legumes, the host range of *S. trifoliorum* is virtually limited to forage legumes. Though Keay (1939) recognized *S. trifoliorum* var. *fabae* on broad bean, recent electrophoretic studies of Wong & Willetts (1975) suggest that this is actually *S. sclerotiorum.* Since type or authentic material was not available I have been unable to corroborate their observations with morphological studies. It must be pointed out that because of confusion over species delimitation in this group, especially in the years since Purdy (1955) placed *S. minor* and *S. trifoliorum* in synonymy under *S. sclerotiorum*, the use of these names in the literature has been inconsistent and confused; reports of host range and distribution of these species must be approached with caution.

As suggested by cultural studies (Sproston & Pease, 1957; Saito, 1977), production of apothecia in nature is dependent upon appropriate light, temperature, and moisture conditions. When collected in nature, apothecia are found in cool weather, arising from moist sclerotia which have developed on decayed plant parts on or in wet to moist soil. While the stipe and sclerotium may be buried in soil, the receptacle is exposed on the soil surface. In temperate regions apothecia are produced in the spring, summer, and fall, with differences in fruiting seasons among species. In tropical regions apothecial production corresponds with seasonal rainfall.

COMPARATIVE STUDIES IN CYTOLOGY, ELECTROPHORETIC ASSAYS, SCLEROTIAL ONTOGENY, AND MYCELIAL INTERACTIONS

In recent years several techniques previously not applied to comparative studies of the economically important species of *Sclerotinia* have been explored in an effort to supplement morphological data and shed light on the delimitation of biological species in this group. These techniques include comparative studies of cytology, electrophoretic assays, sclerotial ontogeny, and mycelial interactions.

Björling (1942, 1951) reported the nuclear number for ascospores of *S. sclerotiorum* and *S. trifoliorum* as 2 and 4 respectively, with the haploid chromosome number for both species of 6. Frandsen (1946) reported that the haploid chromosome number of both species was 8. Recently, Wong & Willetts (1979) have reported for *S. minor* and *S. trifoliorum* 4 nuclei per ascospore while *S. sclerotiorum* has 2 nuclei per ascospore. They also report a haploid chromosome number for hyphal tips and germinating ascospores of 4 for *S. minor* and 8 for *S. sclerotiorum* and *S. trifoliorum*. I have confirmed their findings on nuclear numbers in studies of freshly produced apothecia. While Berthet (1964) reported the nuclear number in ascospores of *S. tuberosa* to be 2 to 6, I observed 2 to 4 nuclei per ascospore. I have not attempted to count chromosomes in these studies.

On the basis of electrophoretic patterns for soluble proteins, arylesterase, acid phosphatase, tetrazolium oxidase, glucose-6-phosphate dehydrogenase (NADP-linked) and reduced nicotinamide adenine dinucleotide phosphate dehydrogenase of forty-seven isolates of *Sclerotinia* species collected from a variety of crops in Australia, New Zealand, North America and Europe, Wong & Willetts (1975) recognized four subgroups among their isolates: Group 1, small sclerotial isolates from a wide variety of host plants; Group 2, large sclerotial isolates from forage legumes; Group 3, large sclerotial isolates from a wide variety of host plants including forage and crop legumes; Group 4, one isolate from *Anemone*. Wong and Willetts interpreted these groups as representing *S. minor*, *S. trifoliorum*, *S. sclerotiorum* and *S. tuberosa* respectively, and concluded that these were four distinct species with *S. tuberosa* "characteristically different" from the other three species. It is interesting to note that on the basis of morphological characters I have also recognized these species, retaining the first three in *Sclerotinia* and transferring *S. tuberosa* to a new genus, *Dumontinia*.

Studies by Willetts & Wong on sclerotial ontogeny (1971) and on mycelial interactions (Wong & Willetts, 1975) lend further support to this delineation of species. The studies on sclerotial ontogeny and their relationship to the circumscription of species based on morphological characters are discussed in Kohn (1979).

CULTURAL STUDIES

Since the species of *Sclerotinia* are most frequently observed under field conditions as the causal agents of plant diseases, and since apothecia of these species have been rather infrequently collected, many attempts have been made over the years to delimit species on the basis of cultural characters of the anamorphs. Studies of this type have usually led to what now seem like excessively broad or narrow species concepts in the light of recent biological, epidemiological, and morphological information about these organisms. While Chivers (1929) found differences in the effect of temperature on the size of sclerotia between *S. intermedia* and *S. minor*, on the basis of other characters I have synonymized them. In one of the few applications of numerical classification to the taxonomy of higher fungi, Morall, Duczek and Sheard (1972) studied 114 isolates, which, except for two isolates identified as *S. trifoliorum*, were initially identified only as *S. sclerotiorum*, for variation and correlation within and between morphology, pathogenicity, and pectolytic enzyme activity. Using agglomerative classification, they found no lines of demarcation between "species" within the group of isolates tested and concluded that their results supported the broad concept of *S. sclerotiorum* put forth by Purdy in 1955 (see Kohn, 1979, for a discussion of Purdy's species concept). In addition to using fewer than the optimum number of characters for numerical classification, and using evenly weighted non-independent characters, as the authors acknowledge, no attempt was made initially to identify the isolates used to assure representation of any variation other than host. It seems probable that 112 isolates of *S. sclerotiorum* were subjected by them to a barrage of numerical analysis (the authors note that the isolates identified as *S. trifoliorum* were "somewhat distinctive"). The use of cultural characters by Willetts and Wong (1971, 1975) in studies of sclerotial ontogeny and mycelial interactions has, on the other hand, provided additional taxonomic characters for the delimitation of species within this group, using isolates initially identified on the basis of morphological characteristics.

The purpose of my cultural studies was not strictly to observe mycelial and sclerotial variation but, more importantly, to explore both the conditions required to produce apothecia and variation in the microanatomical characters of the apothecium currently in use among discomycete taxonomists. Species of *Sclerotinia* are well suited to this type of study; most other discomycetes will not produce apothecia in culture. Since the publication in 1932 of Nannfeldt's *Studien über die Morphologie und Systematik der nicht-lichenisierten inoperculaten Discomyceten*, microanatomical characters of the sterile tissues of the apothecium have been incorporated into descriptions and delineation of taxa, where previously these descriptions were limited to microscopic observations of such characters as size, shape and color of ascospores, asci and paraphyses.

Working with a collection of approximately 65 isolates of species of *Sclerotinia*, *Ciborinia*, *Myriosclerotinia*, and *Botryotinia* from Europe, Australia and New Zealand, Asia and North America, I have observed cultural characteristics and, for 26% of these isolates, apothecial production (see Tables I and II). Apothecia produced *in vitro* were obtained only for isolates finally identified as *S. sclerotiorum*, *S. minor*, and *S. trifoliorum*. Most isolates were derived from diseased tissue, although some were made from single or mass ascospores. Cultures, grown and maintained on DIFCO Potato Dextrose Agar, were transferred to PDA in 9 cm glass petri plates, incubated for 3-4 days at room temperature, then transferred with a 5 mm cork borer from the growing margin of the colony to 500 ml Erlenmeyer flasks containing autoclaved carrot discs and 25 ml distilled water. The flasks were incubated for 4 wk without

TABLE I: *SCLEROTINIA* ISOLATES EXAMINED

Isolates are grouped following final identification. All numbers are those of the Cornell University Plant Pathology Herbarium (CUP).

Isolate	Host	Origin	Source
Sclerotinia sclerotiorum:			
58235*	bean	U.S.A.	Lumsden
58293	bean	U.S.A.	Abawi
58294	bean	U.S.A.	Abawi
59801	bean	U.S.A.	Lumsden
59815*	bean	U.S.A.	Bateman
58298	bean	Australia	Merriman
58243*	bean	Switzerland	Schmidt
58299	lupine	Australia	Merriman
58236*	Alsike clover	Canada	Stelfox
58242*	red clover	Canada	Stelfox
58239	lettuce	U.S.A.	Lorbeer
59802	lettuce	U.S.A.	Lorbeer
59803*	lettuce	U.S.A.	Lorbeer
58297	lettuce	Australia	Merriman
59806	sunflower	Canada	Dueck
58295	star-thistle	Canada	Elliott
58238*	rape	Canada	Stelfox
59804	rape seed	Canada	Dueck
59807	rape seed	Canada	Dueck
59805	rhubarb	Canada	Dueck
58296	tobacco	Switzerland	Schmidt
58240*	?	U.S.A.	Lorbeer
Sclerotinia minor:			
58241*	bean	U.S.A.	Lumsden
58288	bean	Australia	Hawthorne
58233*	white clover	New Zealand	Waters
58290	clover	Australia	Hawthorne
58237*	peanut	U.S.A.	Porter
58232*	lettuce	U.S.A.	Grogan (Abawi)
58286	lettuce	U.S.A.	Lorbeer
59817	lettuce	U.S.A.	Abawi
58234*	cabbage	New Zealand	Waters
58292	cauliflower	Australia	Merriman
58287	tomato	Australia	Hawthorne
58289	potato	Australia	Hawthorne
58285	carrot	Canada	Stelfox
58291*	parsley	Australia	Hawthorne
58284	?	U.S.A.	Lorbeer
Sclerotinia trifoliorum:			
58244*†	red clover	Switzerland	Matheis
58277*	red clover	Switzerland	Schmidt
58278*	red clover	Switzerland	Schmidt
58279	red clover	Switzerland	Schmidt
58254†	possibly clover	Switzerland	Matheis
58282	?	England	Dixon
58283	?	Northern Ireland	Malone

* Apothecia produced *in vitro* from this isolate; photographs and dried apothecia are in deposit in CUP under this number.

† Field-collected apothecia, from which the isolate was made, are on deposit in CUP under this number.

TABLE II: OTHER ISOLATES EXAMINED

Isolates are listed under names based on identifications of field collections of apothecia from which isolates were made. All numbers are those of CUP. Generic name abbreviations: *B. = Botryotinia; C. = Ciborinia; D. = Dumontinia; M. = Myriosclerotinia.*

Isolate	Species	Host	Origin	Source
54929†	*B. ranunculi*	*Ranunculus aconitifolius*	Switzerland	Matheis
59814†	*C. allii*	*Allium cepa*	Japan	Matsuo
58248†	*C. camelliae*	*Camellia japonica*	U.S.A.	Stoner
59810	*C. erythronii*	*Erythronium americanum*	Canada	Elliott
59809	*C. pseudobifrons*	*Populus deltoides*	Canada	Elliott
59811	*C. pseudobifrons*	*Carex* sp.	Canada	Elliott
54733†	*D. tuberosa*	*Anemone nemorosa*	Germany	Matheis
54734†	*D. tuberosa*	*Anemone nemorosa*	Germany	Matheis
58253†	*D. tuberosa*	*Anemone nemorosa*	Belgium	Hennebert
59808	*D. tuberosa*	*Sanguinaria canadensis*	Canada	Elliott
59812	*M. borealis*	*Secale cereale*	Canada	Dueck
59813	*M. borealis*	*Triticum* sp.	Canada	Dueck
56064†	*M. dennisii*	*Eriophorum vaginatum*	Germany	Matheis
54912†	*M. sulcata*	*Carex paradoxa*	Switzerland	Matheis

† Field-collected apothecia, from which isolates were made, are on deposit in CUP under this number; for CUP 59814, apothecia produced in culture are on deposit as CUP 53255 and apothecia collected in the field are deposited under CUP 53252.

light at 15 C. Sclerotia were harvested, rinsed in distilled water, and transferred to sterile preparation dishes containing glass wool saturated with distilled water. The sclerotia were then "cold conditioned" for 4 wk at 0 C. The dishes were removed to a growth chamber set at 15 C, with flourescent and incandescent light at approximately 21,520 lx and a 14 hr photoperiod. Apothecial initials appeared 4-12 wk after introduction to the growth chamber. The subject of apothecial initiation has been studied by many workers; for a review see Saito (1977).

Although the results of my cultural studies are discussed in detail in Kohn (1979), some of the major points have interesting implications in considering species delimitation and phylogenetic relationships in *Sclerotinia*.

In comparing three generations of apothecia produced in culture and in some cases comparing apothecia produced in culture with apothecia of the same isolate produced in nature, I found that tissue types were stable, varying only in the number of cells present in a zone and in compactness, which is often determined by the presence or absence of gel. This agrees with the findings of Christiansen (1966) in studies of several species of *Ciborinia, Ciboria, Lambertella,* and *Rutstroemia.*

Although apothecia of *S. sclerotiorum* usually develop in

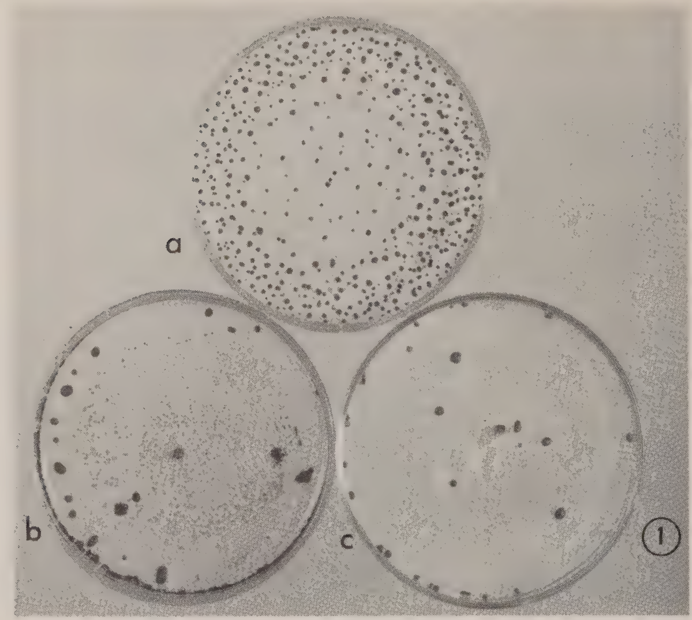


FIG. 1. Patterns of sclerotial formation in *Sclerotinia;* cultures grown for two weeks on PDA in 9 cm glass petri dishes. a. *Sclerotinia minor,* CUP 59817. b. *S. trifoliorum,* CUP 58254; pigmented haptera have formed on the underside of the agar in contact with glass. c. *S. sclerotiorum,* CUP 59818.

spring and early summer, apothecia of *S. trifoliorum* in late summer through autumn, and those of *S. minor* reportedly (Keay, 1939) from June to December, all three species produce apothecia simultaneously under identical conditions *in vitro.* The closely related *Dumontinia tuberosa* was never induced to produce apothecia under these conditions, nor were any other species in other genera of the Sclerotiniaceae tested in these studies. This is another indication that these three species are probably closely related.

Isolates uniformly fell into one of two classes of sclerotial development when grown on PDA at 15-20 C: either small sclerotia scattered abundantly throughout the colony (Fig. 1a), or large sclerotia arranged radially at the periphery of the growing margin of the colony, often forming concentric circles, radiating lines, and similar patterns (Figs. 1b, 1c). According to Willetts and Wong (1971), the small sclerotial form (*S. minor*) develops many small sclerotia laterally on hyphae throughout the colony, while the large sclerotial forms (*S. sclerotiorum,* and *S. trifoliorum*) develop fewer, larger sclerotia at the growing tips of hyphae, at the periphery of the colony. For comparative screening under uniform conditons, this should be a more useful method of distinguishing *S. minor* than the use of sclerotial size alone (see Purdy, 1955).

GENERIC DIAGNOSIS

SCLEROTINIA Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 330. 1870.
(Lectotype: *S. sclerotiorum* (Lib.) de Bary, *typus conserv. propositum.*)
≡ *Ciboria* subg. *Sclerotinia* (Fuckel) Boud., Bull. Soc. Myc. France 1: 115. 1885.
≡ *Whetzelinia* Korf & Dumont, Mycologia 64: 250. 1972 (*nom. rejiciendum prop.*).

Apothecia 2-10 mm wide, stipitate, produced from a sclerotium; receptacle cupulate to convex. Sclerotium produced free from host tissues, not incorporating host tissues within the sclerotial medulla. Asci 8-spored, J+, thin-walled, thickened at the apex. Ascospores uniseriate, smooth-walled, shape predominantly ellipsoid, biguttulate. Subhymenium well developed, of light brown-walled textura intricata, usually bound in gel. Medullary excipulum of hyaline, loosely woven textura intricata. Ectal excipulum of hyaline to light brown-walled textura prismatica oriented perpendicularly to the apothecial surface with cells inflated to globose, tomentum hyphae often present. Microconidia produced superficially on cultures and on surface of hymenium, hyaline, globose, produced from single phialides borne laterally on hyphae, or grouped in sporodochia.

Differing from other genera in the Sclerotiniaceae by: the presence of a tuberoid sclerotium which does not incorporate host tissue and is borne superficially on aerial mycelium; absence of a disseminative conidial state; production of hyaline ascospores; superficial production of microconidia.

KEY TO THE SCLEROTIUM-FORMING GENERA OF THE SCLEROTINIACEAE

1. Apothecia cupulate or verpoid, stipitate, on a distinct sclerotium with a well-differentiated rind and medulla; conidia produced......................not *Sclerotinia* (cfr. *Phaeosclerotinia, Monilinia, Pycnopeziza, Scleromitrula, Botryotinia, Gloeotinia, Septotinia,* etc.)
1. Apothecia cupulate or verpoid, stipitate, on a distinct sclerotium with a well-differentiated rind and medulla; conidia absent except for phialidic microconidia (*Myrioconium*)..............................2

    2. Ascospores brown..................*Martininia*
    2. Ascospores hyaline................3

3. Sclerotial medulla enveloping suscept tissues or, in culture, sclerotia at least partially immersed in the agar 4
3. Sclerotial medulla free of suscept tissues or, in culture, sclerotia formed above the agar surface...............7

    4. Ectal excipulum of apothecium composed of prosenchymatous cells......................*Elliottinia*
    4. Ectal excipulum of apothecium composed of globose cells 5

5. Sclerotia and microconidia produced within the stems of gramineous, juncaceous, and cyperaceous hosts........... ....*Myriosclerotinia*
5. Sclerotia and microconidia produced within the stems of other monocot and dicot families.......6

    6. Apothecia verpoid.................*Verpatinia*
    6. Apothecia cupulate................*Ciborinia*

7. Stroma consisting of a mantling stroma of indefinate dimensions, and smaller sclerotia (sclerotules) formed on aerial mycelium above the mantle; apothecia occurring on the mantling stroma only.............*Stromatinia*
7. Not as above..........................8

    8. Apothecia verpoid.................*Mitrula sclerotiorum* (a presumed parasite on sclerotia of *Sclerotinia* spp.)
    8. Apothecia cupulate................9

9. Outer layer of apothecial ectal excipulum composed of prosenchymatous cells usually embedded in gel............. ....*Dumontinia*
9. Outer layer of apothecial ectal excipulum composed of globose cells........................*Sclerotinia*

KEY TO THE SPECIES OF SCLEROTINIA

1. Ascospores dimorphic in size, showing segregation in ascus, tetranucleate, length/width ratio of ascospores ≤ 2.0; ectal excipulum at margin of apothecium composed of prosenchyma "turning out" perpendicularly to the apothecial surface; sclerotia produced at growing margins of colony only, forming concentric rings, radial lines and other patterns, individual sclerotia 2-20 mm long.................. ....*Sclerotinia trifoliorum*
1. Ascospores uniform in size, no segregation in ascus.......2

    2. Ectal excipulum at margin of apothecium composed of globose cells; ascospores tetranucleate, length/width ratio of ascospores < or > 2.0; sclerotia formed abundantly throughout the colony, sometimes adhering to form an aggregate crust in culture, individual sclerotia 0.5-2 mm long.............*Sclerotinia minor*
    2. Ectal excipulum at margin of apothecium composed of prosenchyma "turning out" perpendicularly to the apothecial surface; length/width ratio of ascospores >2.0, ascospores binucleate; sclerotia produced at the growing margins of colony only, forming concentric rings, radial lines and other patterns, individual sclerotia 2-20 mm long.................*Sclerotinia sclerotiorum*

ACCEPTED SPECIES

1. *Sclerotinia sclerotiorum* (Lib.) de Bary, Vergl. Morph. Biol. der Pilze, Mycet. Bact., p. 22, c. ic. 1884.
    ≡ *Peziza sclerotiorum* Lib., Plant. crypt. Ard. *326*. 1837. (!!)
    ≡ *Helotium sclerotiorum* (Lib.) Fuckel, Fung. rhen. exsicc. suppl. IV. *1861*. 1866. (!!)

≡ *Sclerotinia libertiana* Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 331. 1870 (name change).
≡ *Phialea sclerotiorum* (Lib.) Gillet, Champ. France discomyc. p. 98, c. ic.-73(1). 1881.
≡ *Hymenoscypha sclerotiorum* (Lib.) Phillips, Man. Brit. discomyc., p. 115. 1887.
≡ *Whetzelinia sclerotiorum* (Lib.) Korf & Dumont, Mycologia 64: 250. 1972; [*Whetzeliana sclerotiorum* Wellman, Dictionary of Tropical American Crops and Their Diseases, p. 10. 1977 (*lapsus calami*)]; [*Sclerotinia whetzeliana* Wellman, Dictionary of Tropical Plant Crops and Their Diseases, p. 395. 1977 (*lapsus calami*).]
= [*Peziza sclerotii* Fuckel, Bot. Zeit. (Berlin) 35: 249, c. ic.-X(a-d). 1861 (*nomen nudum*).]
= *Peziza kauffmanniana* Tichomirow, Bull. Soc. Imp. Naturalistes Moscou 4: 295, c. ic.-IV-VII. 1868.
= *Rutstroemia homocarpa* Karst., Bidrag. Kännedom Finlands Natur Folk 19: 107. 1871. (!!)
= *Sclerotinia postuma* Berk. & Wilson, Gard. Chron. 20: 333, c. ic. 1883.
= *Sclerotinia ficariae* Rehm *in* Rabenh., Krypt.-Fl. Deutschl. II, 1(3): 815. 1893. (!!)
= *Sclerotinia opuntiarum* Speg., Anales Soc. Ci. Argent. 50: 37. July, 1900. (!!)
  ≡ *Sclerotinia sclerotiorum* (Lib.) de Bary var. *opuntiarum* (Speg.) Alippi, Revista Fac. Agron. Univ. Nac. La Plata 36: 149. 1960.
= *Sclerotinia moelleriana* P. Henn., Hedwigia 41: 27. 1902.(!!)
= *Sclerotinia wisconsinensis* Rehm, Ann. Mycol. 6: 317. 1908. (!!)
= *Sclerotinia matthiolae* Lendn., Bull. Soc. Bot. Genève 9: 21, c. ic.-1-3, 1917; Bull. Soc. Bot. Genève 9: 221. 1918.
= *Sclerotinia henningsiana* Kirschst., Verh. Bot. Prov. Brandenburg 40: XXVII. 1918. (!)
= *Sclerotinia riograndensis* Rick, Brotéria, Sér. Bot. 25: 99. 1931. (!)
= *Sclerotinia galeopsidis* Velen., Monogr. discomyc. Bohem. 1: 227. 1934. (!!)
= *Sclerotinia caudata* Velen., Novitates Mycol. Novissimae p. 129. 1947. (!!)
= *Sclerotinia sclerotiorum* (Lib.) de Bary forma *orobanches* Narasimhan & Thirumalachar, Phytopath. Z. 22: 426, c. ic. 1954.
= *Sclerotinia xanthorrhoeae* Beaton & Weste, Trans. Brit. Mycol. Soc. 68: 73, c. ic. 1977. (!!)

FIGURES 1c, 2, 3, 4.

Sclerotia borne superficially, usually on dense, white mycelium, globose to cylindrical but quite variable in shape, (2-)5-15(-30) x 2-8(-15) mm, with black outer rind and white inner context; in culture developing at the growing margins of

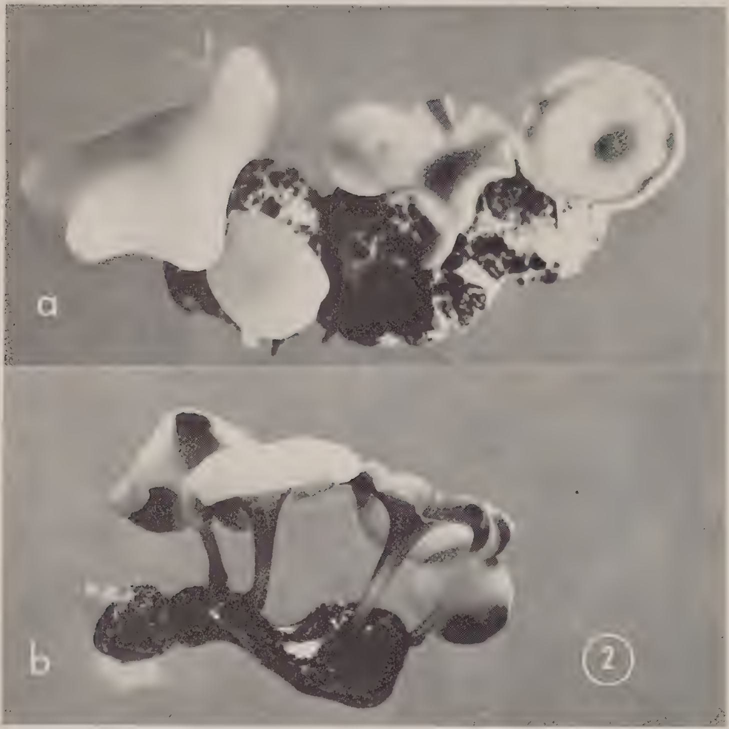


FIG. 2. *Sclerotinia sclerotiorum*, apothecia developed in growth chamber, × 3. a. CUP 58243. b. CUP 58235.

the colony, often forming in concentric rings, radiating lines and other patterns. *Sclerotial medulla* of tightly interwoven, hyaline textura oblita, cells 5-10 µm wide with heavily gelatinized walls 2-3 µm thick. *Sclerotial rind* a 2-6 cell deep layer of textura prismatica originating from medullary cells turning out perpendicularly to the surface, becoming brown-walled, inflated to globose, 5-15 µm in diameter. *Apothecia* arising one to several from a sclerotium, ochraceous (-cinnamon) to umber, often darker at the base of the stipe; receptacle 2-8(-10) mm broad, applanate to slightly concave when young, at maturity applanate to convex, often with a central depression, frequently with an undulate margin, tapering to form a stipe 3-20(-30) mm long, 1-2 mm wide. *Ectal excipulum* 35-140 µm broad, thin-walled, hyaline to pale brown textura prismatica with cells inflated to globose, 5-30 µm wide, sometimes bound in gel, oriented perpendicularly to the apothecial surface, at the margin a brown-walled textura porrecta with inflated apices; outermost excipular cells sometimes giving rise to 1-2-celled tomentum hyphae; ectal excipulum of stipe composed of light brown-walled textura porrecta with one-

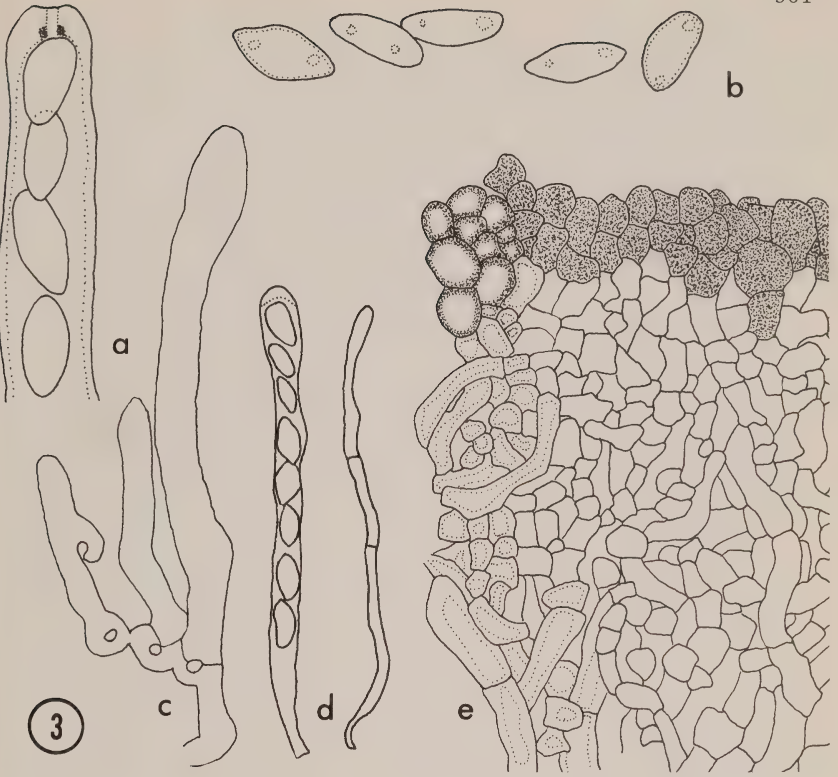
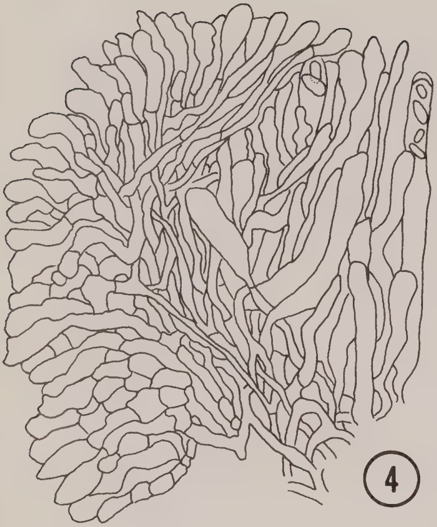
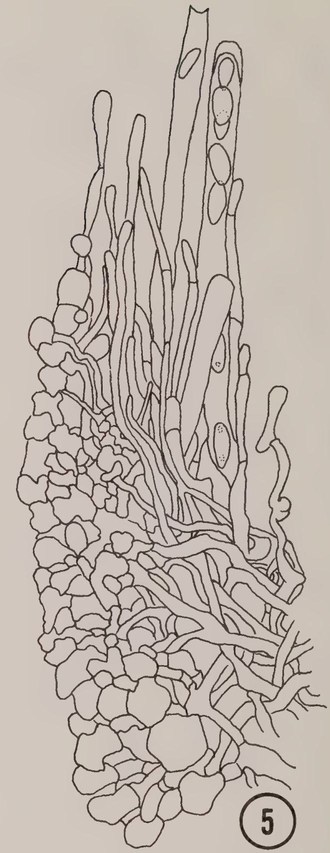


FIG. 3. *Sclerotinia sclerotiorum*, CUP 58252. a. Ascus with J+ pore channel wall, × 1500. b. Ascospores, × 1500. c. Young asci arising from croziers, × 1500. d. Ascus and paraphysis, × 500. e. Cross section of sclerotial rind and medulla; medulla composed of hyaline textura oblita with thick, gelatinized walls; rind composed of textura prismatica with cells becoming inflated to globose and brown-walled, × 500.

celled, inflated tomentum hyphae arising from the outermost cells and turning out perpendicularly from the stipe axis. *Medullary excipulum* of loosely woven, thin-walled, hyaline textura intricata, hyphae 5-15 μm wide, occasionally bluing in Melzer's Reagent, sometimes in two layers, an outer layer of textura porrecta parallel to the apothecial surface, and an inner layer of textura intricata; medullary excipulum of stipe composed of textura porrecta, or of textura oblita with walls 1-2 μm thick; rhomboidal crystals often abundant in receptacle and/or stipe. *Subhymenium* of compact or loosely woven light brown-walled textura intricata, sometimes bluing in Melzer's Reagent and probably bound in gel, hyphae 2-3 μm wide. *Asci* arising from croziers, 8-spored, cylindrical, (110-)130-150 (-160) x 6-10 μm, with a thickened apex, pore channel wall J+. *Ascospores* uniseriate, hyaline, ellipsoid, biguttulate,





FIGS. 4, 5. Cross sections of the margin of the apothecium, × 500. 4. *Sclerotinia sclerotiorum*, CUP 58252; the ectal excipulum at the margin is composed of prosenchyma "turning out" perpendicularly to the apothecial surface. 5. *S. minor*, CUP 58232; the ectal excipulum at the margin is composed of globose cells.

binucleate, (9-)10-14 x 4-5(-6) μm, length/width ratio usually greater than 2.0. *Paraphyses* hyaline, filiform, 2 μm wide, septate, simple or sparsely branched. *Microconidial state* (*Myrioconium*) with microconidia globose, hyaline, 2-4 μm in diameter, produced from phialides in sporodochia or on phiaides borne laterally on hyphae, superficial on hymenium surface or culture.

Habitat: Pathogenic on over 350 spp. of herbaceous plants in 60 families (Schwartz, 1974), including the Leguminosae, Cruciferae, and Umbelliferae. Host of type collection not indicated.

Type locality: The Ardennes region, Belgium.

Type specimen: Libert, ad *Sclerotium tectum*, Aestate, Crypt. Ard. *326* [BR: LIBERT, CRYPT. ARD. *326*, LECTOTYPE of *S. sclerotiorum*].

TYPICAL HOST OF BASIONYM: On *Sclerotium tectum*.

TYPICAL HOSTS OF SYNONYMS: On stems of hemp (*Peziza kauffmanniana*); on soil (*Rutstroemia homocarpa*); from sclerotia in stems of potato (*Sclerotinia postuma*); among *Ranunculus ficaria* (*S. ficariae*); on soil (*S. opuntiarum*); on cat feces (*S. moelleriana*); in moist woods (*S. wisconsinensis*); on stems of cultivayed *Matthiola vallesiaca* (*S. matthiolae*); on rhizomes of *Poa pratensis* L. (*S. henningsiana*); on Myrtaceous fruits *(S. riograndensis)*; on rotted trunk of *Galeopsis versicolor (S. galeopsidis)*; on soil *(S. caudata)*; flowering scape of *Orobanche cernua (S.* *sclerotiorum* f. *orobanches)*; on dried flower spikes of *Xanthorrhoea australis* R. Br. *(S. xanthorrhoeae)*.

EXSICCATI SPECIMENS EXAMINED: (All were issued as *Sclerotinia sclerotiorum* except as indicated.) *Austria:* Rick, Mai 1898, ad terram inter *Ranunculos Ficarias*, Tyrol: prope Feldkirch [FH: RABENFORST-PAZSCHKE, FUNGI EUROPAEI ET EXTRAEUROPAEI *4742* (as *S. ficariae*)]; Rick, 4.1898, in Wurzeln von *Ranunculus Ficaria*, Feldkirch in Vorarlberg [FH: REHM, ASCOMYCETEN *1204* (as *S. ficariae*)]; Zurhausen, 5/1899, in einem *Paeonia...*, Feldkirch in Vorarlberg [FH: REHM, ASCOMYCETEN *1306*].

Bermuda: Whetzel, Jan. 19, 1922, lettuce beds, Agricultural Station, Paget [CUP: WHETZEL, BERMUDA FUNGI *134*].

France: Roumeguère, août-septembre 1886, obtenu par la culture du *Sclerotium compactum* D.C. developpé...de l'*Helianthus annuus*, Jardin de Toulouse [CUP-Durand: ROUMEGUÈRE, FUNGI SELECTI GALLIAEI *3928* (as *Peziza (Sclerotinia) libertiana*)].

Germany: Kirschstein, (date not indicated), on *Poa*-Rhizomen, Rathenow a/H [S, FH: REHM, ASCOMYCETEN *1272* (as *Sclerotinia henningsiana*)].

Italy: Grassi, estate 1892, Da Mantova [FH: BRIOSI E CAVARA, I FUNGHI PARASSITI DELLE PIANTE CULTIVATE OD UTILI *217* (sclerotia only; includes description; issued as *S. libertiana*)]; Pollacci, (date not indicated), ad terram, Horto botanico ticinesi [FH: POLLACCI, FUNGI LONGOBARDIAE EXSICCATI *316* (issued as *S. libertiana* but is actually *Dumontinia tuberosa*)].

Norway: Brunchorst, 18/10 87, in caulibus *Solani tuberosi* ad Sandnaes, Stavanger [FH: ERIKSSON, FUNGI PARASITICI SCANDINAVICI *287* (sclerotia only)].

Poland: Raciborski, Dublany IX. 1905, *Nicotiana tabacum*, (location not indicated) [FH: RACIBORSKI, MYCOTHECA POLONICA *85* (sclerotia only)].

Sweden: Åberg, 21.V.1938 & 29.V.1939, on *Ficaria verna*, Upland: Funbo parish, Hofgården [BPI: LUNDELL & NANNFELDT, FUNGI EXSICCATI SUECICI *994* (as *Sclerotinia ficariae*)]; Ridelius, 14-31. VII 1938, withering *Petroselium sativum*, Dalarna: Norrbärke parish, Smedjebacken, in the garden of the parsonage [BPI: LUNDELL & NANNFELDT, FUNGI EXSICCATI SUECICI *995*]; Lagerberg & Sylvén, Maio 1905, on soil among *Ficariam vernam*, Upland, Linnés Hammarby [FH: VESTERGREN, MICROMYCETES RARIORES SELECTI *994* (as *S. ficariae*)].

Europe (country unknown): (collector not indicated), Autumno, hoc tuberculo excavato (sclerotii spec.?) insidiens, in dumetis alneis, (location not indicated) [FH: FUCKEL, FUNGI RHENANI EXSICCATI SUPPL. IV. *1861* (issued as *Helotium sclerotiorum*; specimen examined detritus only)].

OTHER SPECIMENS EXAMINED, WITH APOTHECIA: *Argentina:* Speggazini, V.1900, S/tierra, La Plata [LPS 28138, HOLOTYPE of *Sclerotinia opuntiarum*)].

Australia: K. & G. Beaton, 6.IX.1964, *Xanthorrhoea australis*, Victoria [MELU 153, HOLOTYPE of *Sclerotinia xanthorroeae*].

Brasil: Müller, 12.1892, auf Sclerotien in Katzenkoth, St. Cather. bei Blumenau [S-Herb. Sydow, HOLOTYPE of *Sclerotinia moelleriana*]; Rick, Sept. 1912, S. Leopoldo [PACA-Fungi Rickiani 14840, AUTHENTIC material of *Sclerotinia riograndensis*].

Canada: Stelfox, (date unknown), *Trifolium hybridum*, Alberta, CUP 58236 = CF 77-5; Stelfox, (date unknown), roots of *Brassica napus*, Alberta, CUP 58238; Stelfox, (date unknown), *Trifolium pratense*, Alberta, CUP 58242 = CF 77-6.

Czechoslovakia: Velenovský, V.1925, in truncis putridis *Galeopsidis versicoloris* in silva frondosa, Roblín [PRM-Flora bohemica 148363, HOLOTYPE of *Sclerotinia galeopsidis*]; Velenovský, 11.VI.1941, sub *Prunus spinosa* in verrimentis, Hrusice [PRM-Flora bohemica 152961, HOLOTYPE of *Sclerotinia caudata*].

Finland: Karsten, Julio, Tavastia australis, Tammela Mustalia [H-Herb. Karsten 905 and 906, PRESUMED SYNTYPES of *Rutstroemia homocarpa*].

Germany: Magnus, 4/67, *Ranunculus ficaria*, Berlin [S-Herb. Rehm, HOLOTYPE of *Sclerotinia ficariae*].

Switzerland: (collector unknown), 1975, "green bean", Changins/Nyon, CUP 58243 = Changins 762.

UNITED STATES: Arizona: Lorbeer, 23.V.1977, *Lactuca sativa*, CUP 59803.

New York: (collector unknown), (date unknown), "bean", CUP 59815 = Bateman 656, Korf 4214; Lorbeer, (date unknown), "bean", CUP 58240; Abawi, 18. IX.1974, "bean", CUP 58252 = Abawi SS-3.

North Carolina: Lumsden, 1968, "bean", CUP 58235 = ATCC 18684.

Wisconsin: Arzberger, 5.V.1908, vegetable mould, Madison [S-Herb. Rehm, HOLOTYPE of *Sclerotinia wisconsinensis*].

OTHER SPECIMENS EXAMINED, WITHOUT APOTHECIA: *Australia:* Merriman, 8.VIII.1973, *Lactuca sativa*, Mildura, CUP 58297 = Victorian Plant Institute 59; Merriman, 7.V.1974, *Phaseolus vulgaris*, Bairnsdale, CUP 58298 = Victorian Plant Institute 61; Merriman, 23.II.1976, *Lactuca sativa*, Mockinya, CUP 58299 = Victorian Plant Institute 63.

Canada: Watson, summer, 1971, *Centaurea diffusa*, Vernon, B.C., CUP 58295 = DAOM 138593; Dueck, Nov. 1977, seed of *Brassica napus*, "Melfort", CUP 59804; Dueck, Nov. 1977, *Rheum* sp., Saskatoon, Saskatchewan, CUP 59805; Dueck, Nov. 1977, *Helianthus annuus*, Saskatoon, Saskatchewan, CUP 59806; Dueck, Nov. 1977, seed of *Brassica napus*, "Melfort", CUP 59807.

Switzerland: (collector unkown), 1972, *Nicotiana* sp., Rhone plain, CUP 58296 = Changins 721.

UNITED STATES: New York: Abawi, (date unknown), "bean", CUP 58293 = Abawi SS-1; Abawi, (date unknown), "bean", CUP 58294 = Abawi SS-18; Lorbeer, 25.VII.1977, *Lactuca sativa*, CUP 59802.

NOTES: I have selected S-Rehm, Ascomyceten *1272* as LECTOTYPE of *Sclerotinia henningsiana*. *Peziza kauffmanniana, Sclerotinia postuma, S. matthiolae*, and *S. sclerotiorum* forma *orobanches* are synonymized here on the basis of diagnoses only. I have been advised by Dr. S. P. Wasser of the Bot. Akad. Sci. Inst. of Ukranian SSR (*pers. comm.*) that the type specimen of *Peziza kauffmanniana* has not been preserved. Material of *S. postuma* and *S. matthiolae* does not appear to exist at K and G respectively. My requests for material of *S. sclerotiorum* forma *orobanches* were never answered by Dr. Thirumalachar, so I do not know whether such material exists or where it may be deposited.

2. *Sclerotinia minor* Jagger, J. Agric. Res. 20: 333, c. ic. 15.XI.1920.

= *Sclerotinia intermedia* Ramsey, Phytopathology 14: 324, c. ic. 1924. (!!)

= *Sclerotinia sativa* Drayton & Groves, Mycologia 35: 526. 1943. (!!)

FIGURES 1a, 5, 6, 7.

Sclerotia borne superficially, irregularly shaped, 0.5-2(-5) mm in diameter, with black outer rind and white inner context; in culture forming abundantly throughout the colony, sometimes adhering to form an aggregate crust of indefinite dimensions. *Sclerotial medulla* of tightly interwoven, hyaline textura oblita, cells 5-10 µm wide with heavily gelatinized walls 2-3 µm thick. *Sclerotial rind* a 2-6-deep layer of textura prismatica originating from medullary cells turning out perpendicularly to the surface, becoming brown-walled, inflated to globose, 5-15 µm in diameter. *Apothecia* arising singly from a sclerotium, cinnamon to umber, sometimes darker at base of stipe; receptacle 2-9 mm broad, cupulate to applanate when young, at maturity applanate with a central depression, margin undulate or somewhat incurved, tapering to form a stipe 1-4 (-12) mm long and 1-2 mm wide that is often broader at the apex than at the base. *Ectal excipulum* 40-100 µm broad, of thin-walled, hyaline to pale brown textura prismatica with cells inflated to globose, 5-35 µm in diameter, sometimes bound in gel, more often only cells at margin bound in gel, oriented perpendicularly to the apothecial surface; outermost excipular cells often giving rise to 1-2-celled tomentum hyphae; ectal excipulum of stipe composed of light brown, thin-walled textura prismatica turning out perpendicularly to the stipe axis, cells 5-35 µm in diameter, giving rise to 1-2-celled tomentum hyphae which are sometimes grouped in fascicles. *Medullary excipulum* of loosely woven, thin-walled, hyaline textura intricata, hyphae 5-20 µm wide; medullary excipulum of stipe composed of textura porrecta parallel to the stipe axis; rhomboidal crystals, often in clusters, usually abundant, especially in medulla of stipe. *Subhymenium* a compact zone, 15-40 µm broad, of pale brown-walled textura intricata, usually bound in gel, often turning blue in Melzer's Reagent, hyphae 2-3 µm wide. *Asci* arising from croziers, cylindrical, 8-spored, (110-)125-180 x 7-11 µm with a thickened apex, without pretreatment in 2% KOH pore channel wall weakly J+ or J-, with KOH pretreatment pore channel wall strongly J+. *Ascospores* uniseriate, hyaline, ellipsoid, biguttulate, tetranucleate, 8-17(-20) x (4-)5-7(-9) µm, length/width ratio greater or less than 2.0. *Paraphyses* hyaline, filiform, 2 µm broad, widening slightly to 3 µm at apices, septate, simple to sparsely branched. *Microconidial state* (*Myrioconium*) with microconidia globose, hyaline, (2-)3-4 µm in diameter, produced from phialides in sporodochia or on phialides borne laterally on hyphae, superficial on hymenium surface or culture.

Habitat: Pathogenic on a wide range of herbaceous plants in several families including the Leguminosae, Compositae, and Cruciferae.

Type Locality: Massachusetts, New York, Pennsylvania, and Florida. NEOTYPE locality: Southampton County, Virginia.

Type specimen: Since no original material appears to exist, a Neotype is designated here: Porter, 1.IX.1974, on *Arachis*

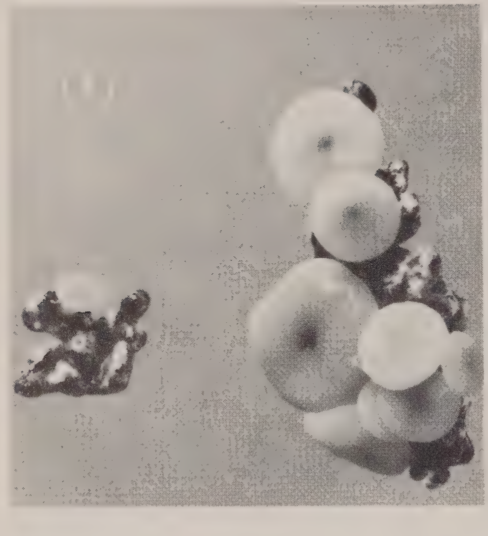


FIG. 6. *Sclerotinia minor*, CUP 58237; apothecia developed in growth chamber, × 3.

hypogaea, Southampton Co., Virginia, CUP 58237.

TYPICAL HOSTS OF BASIONYM: Jagger described this species on *Lactuca sativa* and *Apium graveolens*. The host of the Neotype is *Arachis hypogaea*.

TYPICAL HOSTS OF SYNONYMS: *Tragopogon porrifolius* (*Sclerotinia intermedia*); *Tulipa* and *Melilotus* (*Sclerotinia sativa*).

EXSICATTI SPECIMENS EXAMINED: I know of no exsiccati specimens issued under this name or issued under other names.

OTHER SPECIMENS EXAMINED, WITH APOTHECIA: *Canada:* Drayton & Groves, Mar., Apr. 1940, *Tulipa* and *Melilotus*, CUP 32664 = DAOM 9015, ISOTYPE of *Sclerotinia sativa*.

Japan: Nakata, VI.1924, *Chrysanthemum cinerariifolium*, Okayama, CUP 15520.

New Zealand: Waters, 23.V.1974, *Trifolium repens*, Levin, CUP 58233 = LEV 8374; Waters, 15.XI.1975, *Brassica oleracea* var. *capitata*, Levin, CUP 58234 = LEV 9768; Hawthorne, (date unknown), *Petroselinum crispum*, CUP 58291 = Hawthorne 71.

UNITED STATES: California: Grogan, (date unknown), *Lactuca sativa*, Salinas Valley, CUP 58232 = Abawi SS-6.

Illinois: Ramsey, 12.V.1921, *Tragopogon porrifolius*, Chicago Markets, CUP 15508, HOLOTYPE of *Sclerotinia intermedia*.

Maryland: Lumsden, 1968, "bean," CUP 58241 = ATCC 18687.

Virginia: Beute, spring, 1975, *Arachis hypogaea*, Virginia-North Carolina border, CUP 58249.

OTHER SPECIMENS EXAMINED, WITHOUT APOTHECIA: *Canada:* Jackson, winter, 1925, *Helianthus annuus*, Northern Ontario, CUP 15518; Baribeau, 31.I.1927, *Solanum tuberosum*, Quebec, CUP 16205; Stelfox, 22.II.1974, *Daucus carota* var. *sativa*, Alberta, CUP 58285.

New Zealand: Hawthorne, (date unknown), *Lycopersicum esculentum*, CUP 58287 = Hawthorne 36; Hawthorne, (date unknown), "bean", CUP 58288 = Hawthorne 41; Hawthorne, (date unknown), *Solanum tuberosum*, CUP 58289 = Hawthorne 59; Hawthorne, (date unknown), *Trifolium* sp., CUP 58290 = Hawthorne 67.

UNITED STATES: New York: Whetzel, 17.IX.1919, *Helianthus annuus*, Ithaca, CUP 4056; Jagger, 17.XI.1914, *Lactuca sativa*, Irondequoit, CUP 15517; Jagger, I.1915, *Lactuca sativa*, South Lima, CUP 16204; Lorbeer, (date unknown), (host unknown), CUP 58284; Lorbeer, 3.VII.1977, *Lactuca sativa*, CUP 58286.

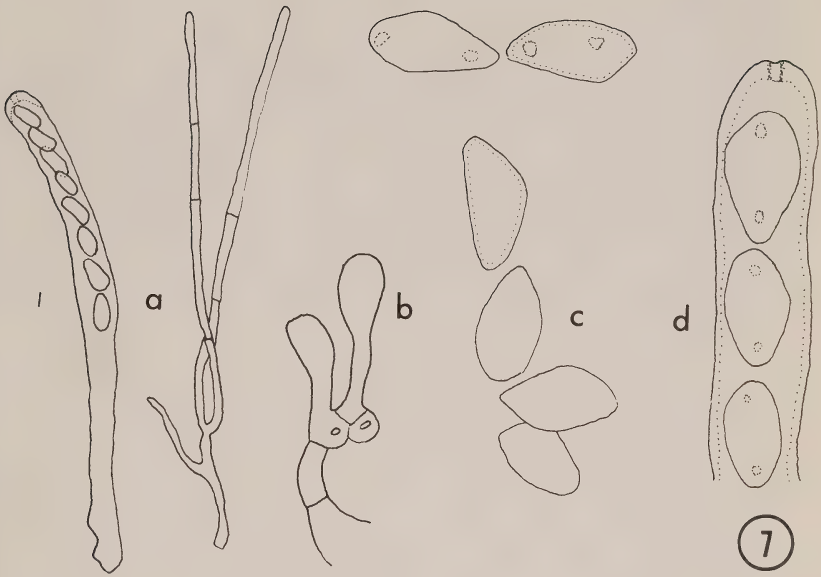


FIG. 7. *Sclerotinia minor*, CUP 58232, a. Ascus and paraphysis, × 500. b. Young asci arising from croziers, × 1500; c. Ascospores, × 1500. d. Ascus with J+ pore channel wall, × 1500.

3. *Sclerotinia trifoliorum* Erikss., Landtbruks-Akad. Handl. Tidskr. 19: 28. 1880. (!!)
= *Peziza ciborioides* Hoffm. *non* Fr. *in* Rabenh., F. europ. exsicc. *619*. 1864 (later homonym of *P. ciborioides* Fr. *ex* Fr., Syst. mycol. 2(1): 117. 1822). (!!)
= *Sclerotinia bryophila* Kirschst., Ann. Mycol. 36: 381. 1938. (!!)
= [*Sclerotinia trifolii* Biffen, J. Roy. Agr. Soc. England 97: 482. 1936 (*lapsus calami*).]

MISAPPLICATIONS:

Peziza ciborioides Fr. *ex* Fr., by Hoffman, Icones Anal. Fung. III, p. 65. 1861; by E. Rehm, J. Landw. 20: 151-178, c. ic. - 1,2. 1872; by H. Rehm, Ascomyceten *107*. 1872.

FIGURES 1b, 8, 9.

Sclerotia borne superficially, globose to cylindrical, 2-12(-20) × 2-8 mm, with black outer rind and white inner context; in culture developing at the growing margins of the colony, often forming in concentric rings, radiating lines and other patterns. *Sclerotial medulla* of tightly interwoven, hyaline textura oblita, cells 5-10 μm wide with heavily gel-

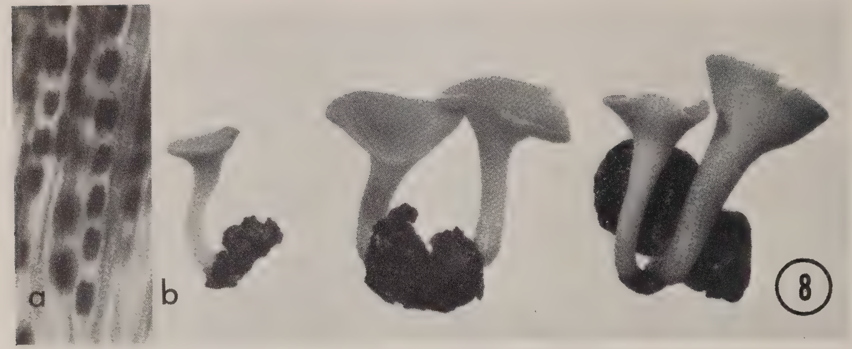
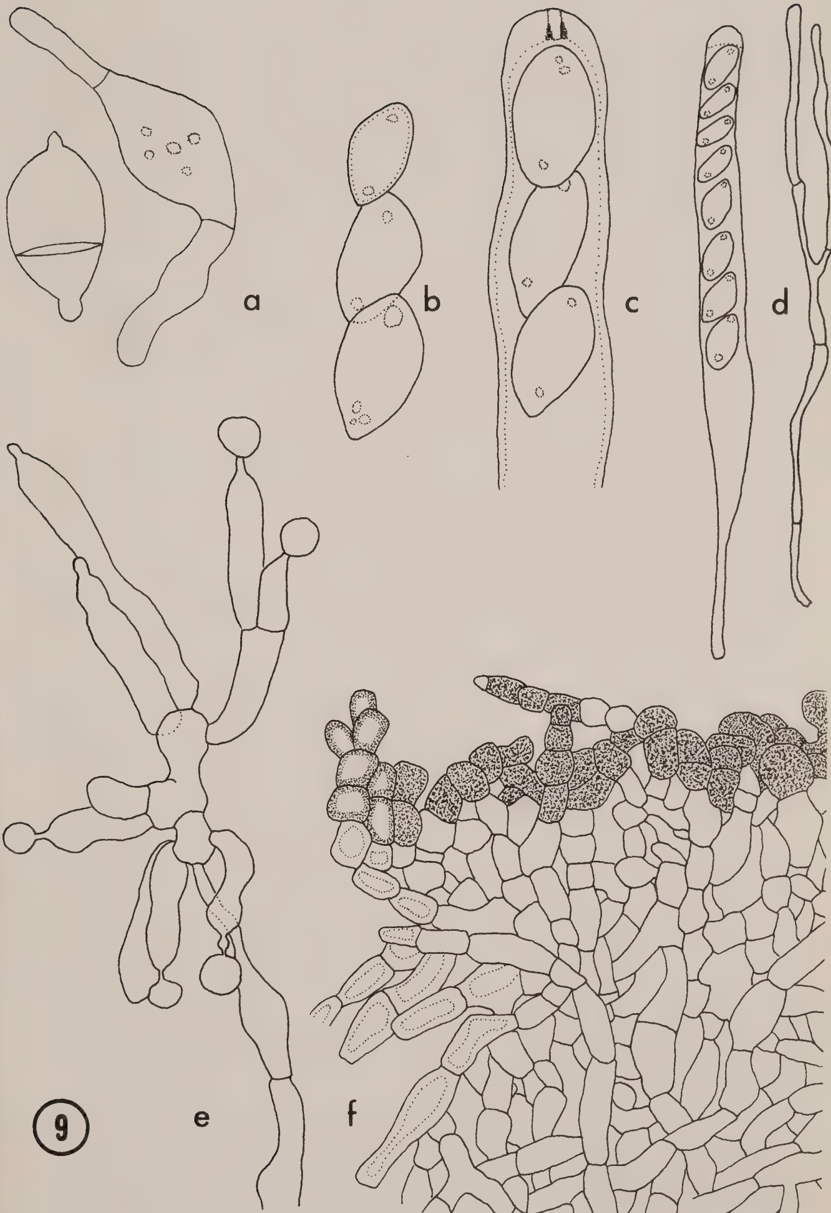


FIG. 8. *Sclerotinia trifoliorum,* CUP 58244. a. Ascospores within asci showing spore dimorphism in 4:4 segregation of large and small ascospores, × 465. b. Apothecia developed in growth chamber, × 3.

atinized walls 2-3 µm thick. *Sclerotial rind* composed of textura prismatica originating from medullary cells turning out perpendicularly to the surface, becoming brown-walled, inflated to globose, 5-15 µm in diameter, continuing past rind as erect, multicelled, brown-walled tomentum hyphae. *Apothecia* arising one to several from a sclerotium, greyish sepia to umber, concolorous though margin and base of stipe may be darker; receptacle 3-7(-10) mm, applanate to slightly concave when young, at maturity cupulate with a central depression, often with an undulate margin, tapering to form a stipe 3-15(-28) mm long and 1-2 mm wide that is often broader at the apex than at the base. *Ectal excipulum* 50-125 µm broad, thin-walled, hyaline to pale brown-walled textura prismatica with cells becoming inflated to globose, 5-20 µm in diameter, oriented perpendicularly to the apothecial surface, at the margin a brown-walled textura porrecta with inflated apices; outermost excipular cells often giving rise to 1-2-celled tomentum hyphae; ectal excipulum of stipe composed of light brown-walled textura prismatica parallel to the stipe axis with one-celled inflated tomentum hyphae arising from the outermost excipular cells and turning out perpendicularly to the stipe axis. *Medullary excipulum* of loosely woven, hyaline, thin-walled textura intricata, hyphae 5-10 µm wide; outer zone often bound in gel, often bluing weakly in Melzer's Reagent; medullary excipulum of stipe composed of hya-

FIG. 9. *Sclerotinia trifoliorum.* a. Germinating ascospores, × 1500. b. Ascospores, × 1500. c. Ascus with J+ pore channel wall, × 1500. d. Ascus and paraphysis, × 500. e. *Myrioconium* microconidial state, young conidiophores in a developing sporodochium produced on aerial hyphae in culture, × 1500. f. Cross section of sclerotial rind and medulla; medulla composed of textura oblita with thick, gelatinized walls; rind composed of textura prismatica with cells becoming inflated to globose and brown-walled; note tomentum hyphae arising from rind cells; × 500. All from CUP 58244 except e, from CUP 58254.



⑨

line textura porrecta parallel to stipe axis. *Subhymenium* a compact zone 15-20 µm broad of light brown-walled textura intricata, hyphae 2-3 µm wide, usually turning blue in Melzer's Reagent and bound in gel. *Asci* arising from croziers, 8-spored, cylindrical, 140-200 x 10-12 µm, with a thickened apex, pore channel wall distinctly J+. *Ascospores* uniseriate, hyaline, ellipsoid to allantoid, biguttulate, tetranucleate, 10-20 x (4-)6-9(-11) µm, dimorphic in size and segregating within the ascus (usually 4:4), larger spores mostly 13-18 x 7-9 µm, smaller spores mostly 10-13 x 6-7 µm, length/width ratio usually less than 2.0, 2-celled in age. *Paraphyses* hyaline, filiform, with apices slightly inflated, 3 µm wide, septate, simple or sparsely branched. *Microconidial state* (*Myrioconium*) with microconidia globose, hyaline, 2-3 µm in diameter, produced from phialides in sporodochia or on phialides borne laterally on hyphae, superficial on hymenial surface or culture.

Habitat: Almost exclusively on forage legumes where it causes serious economic damage as a pathogen, also occurring on uncultivated leguminous plants.

Type Locality: "Klöferåksar vid Landbr. Akad. Experimentafält" (clover fields at the Agr. Experimental field), Sweden.

Type specimen: Since no holotype specimen was designated, a neotype is designated here: Jakob Eriksson, IX.1878 [S-Svensk Svamp Herb. *1a*, NEOTYPE of *Sclerotinia trifoliorum*].

TYPICAL HOST OF BASIONYM: "clover."

TYPICAL HOSTS OF SYNONYMS: In soil (*P. ciborioides* Hoffm.); in soil among mosses (*S. bryophila*).

EXSICATTI SPECIMENS EXAMINED: *Germany:* H. Hoffman, Oct. 1863, in agris argillaceis, Giessen [S-RABENHORST, FUNGI EUROP. *619*, ISOTYPE of *Peziza ciborioides* Hoffman *non* Fr.]; E. Rehm, 11/1872 com., parasitisch auf *Trifolium sativum*, Beberbeck in Hessen [NY-REHM, ASCOMYCETEN *107*]; (collector not indicated), 7/1906, Kleeacker in Buchsbergtal, Oberschlesien [S-REHM, ASCOMYCETEN *107b*]; Magnus, 10/1906, Versuchsfeld kais. biol. vers-Anstalt [S-REHM, ASCOMYCETEN *107c*].

OTHER SPECIMENS EXAMINED, WITH APOTHECIA: *Germany:* Kirschstein, 12.XI.1938, im Boden zwischen Moosen, Rodelberg, Berlin-Niederschönhausen [B-Kirschstein (Isotype of *S. bryophila*); Winterhoff, 6.XI, 1977, from sclerotia embedded in moss, Nahetal near Bad Münster, Rotenfels, CUP 58254 = Matheis 793.

Switzerland: (collector unknown), 1960, *Trifolium pratense*, Changins, CUP 58277 = Changins 389; (collector unknown), 1960, *Trifolium pratense*, Changins, CUP 58278 ≐ Changins 397; Matheis, 9.XI.1975, *Trifolium repens*, "Lomiser Wald", Kt. Thurgan, CUP 54721; Kohn, 28.III.1978, apothecia of CUP 54721 (isolate) produced in culture, CUP 58244.

UNITED STATES: New York: Sproston, 29.XI.1939, *Trifolium pratense*, Grass Nursery, Ithaca, CUP 28896; Sproston, 22.XI.1939, *Lotus corniculatus*, Grass Nursery, Ithaca, CUP 28897.

OTHER SPECIMENS EXAMINED, WITHOUT APOTHECIA: *England:* Dixon, (date unknown), (host unknown), Sparsholt, CUP 58282.

Northern Ireland: Malone, (date unknown), (host unknown), CUP 58283.

Switzerland: (collector unknown), 1973, *Trifolium pratense*, Changins, CUP 58279 = Changins 702.

NOTES: This species has been confused with *Sclerotinia sclerotiorum* which also occurs on forage legumes in addition to a wide range of other host plants.

TAXA IMPERFECTLY KNOWN

Unless otherwise noted, type and/or authentic specimens were unavailable for the following taxa, The diagnoses are insufficient to determine the species, or in some cases the appropriate generic position.

4. *Sclerotinia bresadolae* Rick, Oesterr. Bot. Z. 50: 121. IV. 1900.

TYPICAL HOST: On rotting insect galls on *Quercus*.

5. *Sclerotinia brevipes* (van den Bosch) Boud., Hist. classific. discomyc. Europe, p. 107. 1907.
≡ *Peziza brevipes* van den Bosch, Prodr. fl. bat. 2(3): 398. 1858.

TYPICAL HOST: On *Alnus* trunk.

6. *Sclerotinia bulborum* (Wakker *in* Oudemans) Sacc., Syll. fung. 8: 197. 1889.
≡ *Peziza bulborum* Wakker *in* Oudemans, Ned. Kruidk. Ark., ser. 2, 4: 260, c. ic. - VII(11). 1885.

TYPICAL HOST: Bulbs of *Hyacinthus*.

NOTES: Diagnoses in Rehm (1893), Saccardo (1889), and Dennis (1956) all appear to be taken from the original description by Wakker. Dennis suggests that Wakker was the only person to have seen apothecia.

7. *Sclerotinia capillipes* (Quél.) Sacc., Syll. fung. 8: 198. 1889.
≡ *Phialea capillipes* Quél., Bull. Soc. Bot. France 23: 331, c. ic-III(16). 1876.

TYPICAL HOST: Among twigs in an aquatic situation.

NOTES: With fusiform sclerotia and lanceolate to fusiform ascospores, this species may belong in *Myriosclerotinia*, especially considering its aquatic habitat.

8. *Sclerotinia caricina* Velen., Monogr. discomyc. Bohem. 1: 224; 2: pl. XXII(40). 1934. (!!)

TYPICAL HOST: Roots of *Carex muricata* among *Juncus*.

SPECIMEN EXAMINED: Velenovsky 4.V.1929 [PRM-Flora bohemica 152957 (Holotype)].

NOTES: The type specimen did not include apothecia, but did include sclerotia with microanatomical characteristics agreeing with those of *S. sclerotiorum*.

9. *Sclerotinia carlinae* Velen., Monogr. discomyc. Bohem. 1: 227; 2: XXX(22). 1934.

TYPICAL HOST: On scales (pappus?) of *Carlina acaulis*.

10. *Sclerotinia carpini* Klika, Čas. Nár. Mus. Odd. Přir. 97 (2/3) pt. 2: 98. 1923.

TYPICAL HOST: Fruits of *Carpinus*.

11. *Sclerotinia dubia* McAlp., Agric. Gaz. New South Wales 7: 86, c. ic. 1896.

TYPICAL HOST: On rich soil on sea shore.

NOTES: The type specimen has not been seen, but the description suggests this is a later synomym of *S. sclerotiorum* or *S. trifoliorum.*

12. *Sclerotinia fagopyri* Hori, J. Pl. Protect. 3: 171, c. ic. 1916.

TYPICAL HOST: Sclerotia form within the seeds of *Fagopyrum esculentum* Moench.

NOTES: An English description is published in Mycologia 9: 172. 1917.

13. *Sclerotinia filipes* (Phill.) Sacc., Syll. fung. 8: 198. 1889.
≡ *Hymenoscyphus filipes* Phill. (ut "*Hymenoscypha*"), Brit. discomyc., p. 116. 1887.

TYPICAL HOST: Amongst vegetable fragments in a damp situation.

14. *Sclerotinia fuckeliana* (de Bary) Fuckel var. *jeanperli* Boud., Hist. classific. discomyc. Europe, p. 107. 1907.

TYPICAL HOST: Not indicated, in a marsh.

15. *Sclerotinia helvelloidea* P. Henn., Hedwigia 41: 27. 1902. (!!)

TYPICAL HOST: Not indicated.

SPECIMEN EXAMINED: A. Möller, X. 1892 [S-Sydow (Holotype)].

NOTES: Although apothecial characters suggest that this may be a *Sclerotinia,* the sclerotium is unknown for this species and a conclusive determination is not possible. The stipe is deeply buried in soil according to the diagnosis.

16. *Sclerotinia johanssonii* Starb., Bih. Kongl. Svenska Vetensk.-Akad. Handl. [3]21(5): 37, c. ic. 1895. (!!) (!)

TYPICAL HOST: Withered leaves of *Arabis alpina* L.

SPECIMENS EXAMINED: C.J. Johansson, Hort. bot. Upsal., apothecia and sclerotia in spirits [UPS, no date, no number (presumed Holotype)]; Johansson & Starbäck, Maj 1887 [S, no number (part of presumed Holotype, sclerotia only)]; Starbäck, Majo sclerotia, Augusto apoth. [S, no number (Authentic)].

NOTES: Only the UPS collection contained apothecia, which have been preserved in liquid and are in very poor condition. On the basis of sclerotial characters, the original description and illustrations, this is probably a synonym of *S. sclerotiorum,* but a conclusive determination is impossible due to the paucity and poor quality of type and authentic material. I treat Vestergren's (Bot. Not. 1899: 164. 1899) use of '*S. johanssoni* f. *sclerotifera,*' without description, as merely the indication of the sclerotial anamorph, and not as a new forma.

17. *Sclerotinia kirschsteiniana* P. Henn., Verh. Bot. Vereins Prov. Brandenburg 41(2): ix. 23.I.1900.

TYPICAL HOST: In peat moss.

18. *Sclerotinia kitajimana* Ito & Hosaka, Bull. Gov. Forest Exp. Station 51: 17, c. ic. 1951.

TYPICAL HOST: Dead leaves of *Cryptomeria japonica*.

19. *Sclerotinia miyabeana* Hanzawa, Miyabe-Festschrift, or a Collection of Botanical Papers, p. 218. 1911.

TYPICAL HOST: Stems of *Arachis hypogaea* L.

20. *Sclerotinia nicotianae* Oud. & Koning, Verslag Gewone Vergaderingen Afd. Wis. Natuurk., Kon. Akad. Wetensch. 12(1): 58, c. ic. f. 1-11. XII.1903.

TYPICAL HOST: *Nicotiana tabacum* L.

21. *Sclerotinia nigromarginata* Velen., Novit. mycol., p. 189. 1939. (!!)

TYPICAL HOST: Among herbs.

SPECIMEN EXAMINED: Velenovský, IX.1939 [PRM-Flora bohemica 152960 (Holotype)].

NOTES: According to the description, no sclerotia were collected with the type collection. The apothecial anatomy agrees with that of *S. sclerotiorum*, however.

22. *Sclerotinia pirolae* Grosse, Ann. Mycol. 10: 388. 1912.
 ≡ *Stromatinia pirolae* (Grosse) Naumov *in* Kursanov [ut "Grosse"], Keys lower pl. 3: 379. 1954.

TYPICAL HOST: Capsules of *Pirola rotundifolia*, *P. minor*, *P. chlorantha*, *P. uniflora*, and *P. media*.

NOTES: The sclerotia are 2 to 5 on a capsule. It seems doubtful that this could be a *Stromatinia*.

23. *Sclerotinia pocula* (Swartz *in* Pers. *ex* Pers.) Boud., Hist. classific. discomyc. Europe, p. 107. 1907.
 ≡ [*Peziza pocula* Swartz *in* Pers., Syn. meth. fung., p. 659. 1801.]
 ≡ *Peziza pocula* Swartz *in* Pers. *ex* Pers., Mycol. eur. 1: 277. 1822.
 ≡ *Geopyxis pocula* (Swartz *in* Pers. *ex* Pers.) Sacc., Syll. fung. 8: 67. 1889.

TYPICAL HOST: Not indicated.

NOTES: No mention is made of a sclerotium in Swartz, Persoon, or Saccardo.

24. *Sclerotinia rubi* Carm., Introduction of Pathogenic Microbes (Yunyā Shokubutsu Byōkin), p. 10. [date?]; *in* J.A. Stevenson, U.S.D.A., Foreign Plant Diseases, p. 159. 1926 (listing).

TYPICAL HOST: *Rubus fruticosus.*

NOTES: I have been unable to trace this reference, taken from Hara (1954), which also appeared in Stevenson's list. Dr. Yoshio Otani, of the National Science Museum, Tokyo (*pers. comm.*), has suggested that the name appeared in a list of imported plant pathogens which was published by the Plant Quarantine Office and that the fungus was never collected in Japan.

25. *Sclerotinia sclerotiacea* (Ces. *in* Rabenh.) Rehm *in* Sacc. & Sacc. *in* Sacc., Syll. fung. 18: 44. 1906.

≡ *Peziza sclerotiacea* Ces. *in* Rabenh., Herb. Myc. I, *1532*. 1851. (!!)

TYPICAL HOST: In a field of *Triticum.*

SPECIMEN EXAMINED: Cesati, Maji 1850 [BR- and FH-Rabenh. Herb. Myc. I, *1532* (Isotype)].

NOTES: The meager specimens in poor condition allow no conclusive determination.

26. *Sclerotinia trifoliorum* Erikss. var. *fabae* Keay, Ann. Appl. Biol. 26: 244. V.1939.

TYPICAL HOST: *Vicia faba* L.

NOTES: No type or authentic specimens appear to exist and Dr. Keay was unable to offer further information on their possible location. I do not know whether this is actually a variety of *S. trifoliorum* or, as Wong and Willetts (1975) have suggested, is *S. sclerotiorum.*

27. *Sclerotinia tuba* (Batsch *ex* Pers.) Sacc., Syll. fung. 8: 201. 1889.

≡ [*Peziza tuba* Batsch, Elench. fung., p. 122. 1783.]

≡ *Peziza tuba* Batsch *ex* Pers., Mycol. eur. 1: 235. 1822 [*non P. tuba* Bolt. *ex* Pers., Mycol. eur. 1: 278. 1822 : Fr., Syst. mycol. 3(index): 138. 1832], devalidated, ICBN Art. 13.1(f).

≡ *Peziza tubaeformis* Fr., Syst. mycol. 3(index): 138. 1832 [*non P. tubaeformis* Gray, 1821, devalidated by Art. 13.1(f)].

TYPICAL HOST: Not indicated.

NOTES: Boudier (1907) thought this species "probably" synonymous with *S. tuberosa.*

28. *Sclerotinia vesicaria* Giesenh., Ber. Bayer. Bot. Ges. 11: 169. 1907.

TYPICAL HOST: Between utricles of dead *Carex vesicaria* L. in peat.

EXCLUDED TAXA AND SYNONYMS

29. *Sclerotinia aconitincola* Rehm, Ber. Bayer. Bot. Ges. 15: 242. 1915. (!!)

TYPICAL HOST: On dry flower stalks of *Aconitum napellus.*

SPECIMEN EXAMINED: Rehm, 9/[1]905 [S-Rehm (Holotype)].

NOTES: I concur with G. Hennebert, who has annotated the specimen as "surely a *Botryotinia* species.... I presume it is an [otherwise] undescribed species." Transfer of the species is deferred until cultural studies of fresh material are performed.

30. *Sclerotinia acutispora* Velen., Nov. mycol. p. 208. 1939. (!!)

TYPICAL HOST: In moist soil among various herbaceous plants under *Carpinus.*

SPECIMEN EXAMINED: J. Velenovský, 16.V.1940 [PRM-Flora bohemica 152964 (Holotype)].

NOTES: Although no apothecia were found in the type specimen, much host tissue was found incorporated in the sclerotial medulla. Tissue structure of the sclerotium suggests that this may be a species of *Ciborinia.*

31. *Sclerotinia adusta* (Karst.) Sacc. (ut "Karst."), Syll. fung. 8: 197. 1889.
   ≡ *Rutstroemia adusta* Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 13 (n.s. 10): 448. 1874.

TYPICAL HOST: On dead, withered leaves of *Betula.*

NOTES: The type specimen of this species was not available from Helsinki. The description explicitly indicates that the sclerotia are innately attached to leaves of *Betula*, suggesting that this is probably a species of *Ciborinia.*

32. [*Sclerotinia adjusta* anon., Mycologia Index volumes 1-58, p. 423. 1968, *lapsus calami* for *S. adusta.*]

33. *Sclerotinia aestivalis* Pollock, Annual Rep. Michigan Acad. Sci. 11: 53. 1909.
   ≡ *CIBORIA AESTIVALIS* (Pollock) Whetzel *in* Harrison, Mycologia 27: 317. 1935.

TYPICAL HOST: Mummified fruits of *Malus.*

34. *Sclerotinia allii* Sawada, Descriptive catalogue of Formosan Fungi: Part I. Agricultural Experiment Station, Government of Formosa, Special Bull. 19: 206. 1919.
   ≡ *Botryotinia allii* (Sawada) Yamamoto *in* Yamamoto, Oyasu & Iwasaki, Sci. Rep. Hyogo Univ. Agric., Biol. Ser. 2: 20. 1956.
   ≡ *CIBORINIA ALLII* (Sawada) Kohn, Phytopathology (in press). 1979.

TYPICAL HOSTS: Parasitic on the leaves and stalks of *Allium fistulosum* and *A. cepa*.

SPECIMENS EXAMINED: CUP-SA 636, R.P. Korf, K.P. Dumont, H. J. Su & C.C. Chien, on sclerotia in leaves of *Allium fistulosum* L., exp. plots adjacent to Taiwan Agr. Res. Inst., Taipei, Taiwan, 30.III.1966 (Topotype and NEOTYPE, designated here); CUP-SA 633, K. Sawada, I.29.1913 (Syntype: sclerotia only); CUP-SA 634, Y. Ishihara, 5.23.1913 (Syntype: sclerotia only); CUP 58247, W.S. Wu, 28.III.1978.

NOTES: In the absence of any of the original teleomorphic material, the apothecial material collected in the type locality by Korf et al. has been designated the Neotype.

35. [*Sclerotinia alni* Nawashin, Ber. Deutsch. Bot. Ges. 12: 118. 1894, *nom. nud.*]

36. *Sclerotinia alni* Maul, Hedwigia 33: 215. 1894.
    ≡ *Ciboria alni* (Maul) Whetzel, Mycologia 37: 675. 1945.

TYPICAL HOST: Fruits of *Betula alnus* var. *glutinosa* L.

NOTES: This epithet is based upon anamorphic states; see notes under *S. alni* O. Rostr.

37. *Sclerotinia alni* O. Rostr., Z. Pflanzenkrankh. 7: 258. 1897 (later homonym).
    ≡ *Ciboria alni* (O. Rostr.) Buchw., Friesia 3: 257. 1947 (later homonym).

TYPICAL HOST: *Alnus incana.*

NOTES: According to Buchwald (1947), *S. alni* Maul and *C. alni* (Maul) Whetzel, based on anamorphic states, are taxonomic synonyms of Rostrup's fungus. There appears to be no valid name for this teleomorphic fungus.

38. *Sclerotinia amelanchieris* Reade, Ann. Mycol. 6: 114. 1908.
    ≡ *MONILINIA AMELANCHIERIS* Honey [ut "(Reade)"], Mycologia 34: 575. 1942.

TYPICAL HOST: fruits of *Amelanchier canadensis* (L.) Medic.

NOTES: Reade's epithet is based upon the anamorph, while that of Honey is based upon the teleomorph.

39. [*Sclerotinia americana* (Wormald) Norton & Ezek., Phytopathology 14: 31. 1924 (not validly published).]
    ≡ [*Monilia cinerea* f. *americana* Wormald, Ann. Bot. 34: 168. 1920 (nomen provisiorum).]
    ≡ [*Sclerotinia cinerea* f. *americana* (Wormald) Norton & Ezek. (ut "Wormald"), Phytopathology 14: 31. 1924 (not validly published).]

TYPICAL HOST: Stone and sometimes pome fruits.

NOTES: Since Wormald published the name *Monilia cinerea* Bon. f. *americana*, based on anamorphs, the combinations in *Sclerotinia* are also based on anamorphs, and, moreover, on a provisional name. Seaver (1951) considered this species to be a taxonomic synonym of *Monilinia fructicola* (Wint.) Honey.

40. *Sclerotinia angustior* Reade, Ann. Mycol. 6: 113. 1908.

TYPICAL HOST: Twigs, leaves and fruit of *Prunus virginiana* L.

NOTES: Whetzel (1945) considered this species to be a taxonomic synonym of *Monilinia padi* (Woron.) Honey.

41. *Sclerotinia arachidis* Hanzawa, Miyabe-Festschrift, or a Collection of Botanical Papers, p. 215, c.ic. - pl. 20. 1911.
≡ *BOTRYOTINIA ARACHIDIS* (Hanzawa) Yamamoto, Trans. Mycol. Soc. Japan 2(2): 4. 1959.

TYPICAL HOST: Leaves and stems of *Arachis hypogaea* L.

42. *Sclerotinia arctica* Elliott, Canad. J. Bot. 42: 1068. VIII.1964. (!!)

TYPICAL HOST: severely decayed buried culm bases of *Carex aquatilis* Wahlenb. var. *stans* (Drej.) Boott.

SPECIMENS EXAMINED: D.B.O. Savile, 4 July 1962 [DAOM 89983 (Holotype)]; D.B.O. Savile, C.T. Watts & J.R. Vockeroth, July 21, 1950 [DAOM 34444]; S. Stephens, June 26, 1962 [DAOM 91035].

NOTES: This species belongs in *Myriosclerotinia*, and despite the host, *Carex*, spore size and shape suggest that this is a synonym of *M. vahliana* (Rostr.) Buchw.

43. *Sclerotinia ariae* Schell., Centralbl. Bakteriol., 2 Abth. 12: 735. 3.IX.1904.
≡ *MONILINIA ARIAE* (Schell.) Whetzel, Mycologia 37: 672. 1945.

TYPICAL HOST: *Sorbus aria* Crantz.

44. *Sclerotinia aschersoniana* Henn. & Plött., Verh. Bot. Vereins Prov. Brandenburg 41: 9. 23.I.1900.
≡ *CIBORIA ASCHERSONIANA* (Henn. & Plött.) Whetzel, Mycologia 37: 676. 1945.

TYPICAL HOST: Fruits of *Carex stricta* Good.

45. *Sclerotinia aucupariae* Ludwig [Ber. Deutsch. Bot. Ges. 8: (208). 1890 (nomen nudum)] *in* Woronin, Mém. Acad. Imp. Sci. Saint Pétersbourg, sér. VIII, 2(1): 15, c.ic. - V. 1895.
≡ *MONILINIA AUCUPARIAE* (Ludwig *in* Woronin) Whetzel [ut "(Ludwig)"], Mycologia 37: 672. 1945.

TYPICAL HOST: Mummified fruits of *Sorbus aucuparia* L.

46. *Sclerotinia azaleae* (Weiss) Dennis, Mycol. Pap. 62: 159. 1956.
≡ *OVULINIA AZALEAE* Weiss, Phytopathology 30: 243. 1940.

TYPICAL HOST: *Rhododendron* spp., flowers of cultivated azaleas and rhododendrons, *Kalmia*, and *Vaccinium*.

47. *Sclerotinia baccarum* (Schroet.) Rehm, Hedwigia 24: 9. 1885.
≡ *Rutstroemia baccarum* Schroet., Hedwigia 18: 180. 1879.
≡ *MONILINIA BACCARUM* (Schroet.) Whetzel, Mycologia 37: 672. 1945.

TYPICAL HOST: Berries of *Vaccinium myrtillus*.

48. *Sclerotinia baccata* Fuckel, Jahrb. Nassausichen Vereins Naturk. 23-24: 331, c.ic. - IV(38). 1870.

TYPICAL HOST: On wet soil under *Fagus*.

NOTES: This is a taxonomic synonym of *Microstoma protracta* (Fr.) Kanouse, Mycologia 40: 486. 1949.

49. *Sclerotinia batschiana* Zopf *in* Zopf & Sydow, Mycoth. march. *50*. 1879.
≡ *CIBORIA BATSCHIANA* (Zopf *in* Zopf & Sydow) Buchw., Friesia 3: 255. 1947.

TYPICAL HOST: On acorns of *Quercus pedunculata*.

50. *Sclerotinia betulae* Woron. *in* Nawashin, Trudy Imp. S.-Peterburgsk. Obšč. Estestvoisp., Vyp. 3, Otd. Bot. 23: 131. 1893.
≡ *CIBORIA BETULAE* (Woron. *in* Nawashin) White [ut "(Nawashin)"], Lloydia 4: 171. 1941.

TYPICAL HOST: On fallen aments of *Betula*.

51. *Sclerotinia bifrons* Seaver & Shope, Mycologia 22: 1. 1930.
≡ *Sclerotinia confundens* Whetzel, Mycologia 32: 126. 1940 (superfluous name change), q.v.
≡ *CIBORINIA SEAVERI* Groves & Bowerman, Canad. J. Bot. 33: 581. 1955 (a name change).

TYPICAL HOST: Leaves of the Rocky Mountain form of *Populus tremuloides*.

52. *Sclerotinia bifrons* Whetzel, Mycologia 32: 126. 1940 (later homonym).
≡ *Ciborinia bifrons* (Whetzel) Whetzel, Mycologia 37: 668. 1945.
≡ *Sclerotinia whetzelii* Seaver, Mycologia 32: 127. 1940 (a name change), q.v., No. 257 of this list.

TYPICAL HOST: Diseased leaves of *Populus tremuloides*.

53. *Sclerotinia borealis* Bub. & Vleugel *in* Vleugel, Svensk Bot. Tidskr. 11: 308. 1917. (!!)
≡ *MYRIOSCLEROTINIA BOREALIS* (Bub. & Vleug. *in* Vleug.) Kohn, Phytopathology (in press). 1979.

TYPICAL HOST: In culms of cultivated *Dactylis glomerata*.

SPECIMENS EXAMINED: F. Bubák, X.1914 [BPI (Holotype)]; J. Dueck, isolate from fall rye, Saskatoon, Saskatchewan, Canada, IV.1974 (CUP 59812); J. Dueck, isolate from winter wheat, Saskatoon, Saskatchewan, Canada (CUP 59813).

54. [*Sclerotinia brunneo-carpa* Ramsbottom & Balfour-Browne, Trans. Brit. Mycol. Soc. 34: 79. 1951, *lapsus calami* for *S. homoeocarpa.*]

55. *Sclerotinia bryophila* Kirschst., see *S. trifoliorum,* No. 3 of this list.

56. [*Sclerotinia calthae* Whetzel *in* Buchwald, Aarskr. Kgl. Veterinaer- og Landbohøjskoles 32: 134. 1949 *(nomen nudum)*.]
   = *BOTRYOTINIA CALTHAE* Hennebert & Elliott *in* Hennebert & Groves, Canad. J. Bot. 41: 343. 1963.

TYPICAL HOST: Petioles of *Caltha palustris* L.

NOTES: Buchwald was apparently unaware that Whetzel knew of two fungi on *Caltha palustris,* one *Verpatinia calthicola* Whetz., the other this fungus.

57. *Sclerotinia camelliae* Hara, Dainippon Saurin Kaiho (Bull.) 436: 31. 15.III.1919. (!!)

TYPICAL HOST: Fallen flower bud, calyx, flowers, etc. of *Camellia.*

SPECIMEN EXAMINED: K. Hara, 1913-V [TNS-Hara 209284 (Holotype)].

NOTES: This is either a species of *Moellerodiscus* or of an as yet unnamed genus in the Sclerotiniaceae. The stroma is substratal with a poorly differentiated rind of textura epidermoidea. There are no globose cells in the ectal excipulum of the apothecium but rather prosenchyma turning out perpendicularly to the apothecial surface, with somewhat inflated cells.

58. [*Sclerotinia camelliae* Hansen & Thomas, Phytopathology 30: 170. 1940 (not validly published, no Latin diagnosis).]
   ≡ *CIBORINIA CAMELLIAE* Kohn, see below. (!!)

TYPICAL HOST: Flowers of *Camellia japonica* L.

SPECIMEN EXAMINED: M. Stoner, Pomona, Calif., III.1977 [CUP 58248 (Holotype)].

NOTES: To the best of my knowledge the original material is either non-existant or unavailable; there was no mention of type or authentic specimens in the original description. The sclerotial medulla incorporates much host tissue. Since the epithet was published after 1935 without a Latin diagnosis, the following is provided:

Ciborinia CAMELLIAE Kohn, *sp. nov.*

Apothecia singularia vel aggregata, bubalino-olivacea, maturitate atrantia, parce pubescentia, discus cyathiformis demum discoideus, 5-20 mm in diam., stipes 3-40 mm longus, 2-3 mm in diam. infra discum decrescens ad 0.5-1.0 mm ad basim. Asci cylindracei 4.3-5.8 × 100-125 µm. Ascosporae 8, uniseriatae, ellipsoideae, continuae, hyalinae, 2.5-3.5 × 5.3-7.0 µm. Paraphyses filiformes, septatae, 1.2-2.5 × 110-130 µm, apicibus parum incrassatis. Sclerotia atrobrunnea vel nigra, plerumque composita, substantiam petalorum infestantia et cingentia, in ambitu valde variabilia, usque ad 12 × 30 mm magnitudine, plerumque lamellata et dispositionem imbricatam petalorum quorundam florum simulantia. Conidia nulla. Microconidia globosa vel pyriformia 2.5-3.5 µm, catenata, hyalina sub magnificatione majore, nigra in conglomeratione, elata in sporodochio composito ex fasciculis numerosis conidiophororum terminantium in cellulas elongatas gradatim angustatas in quibus efferuntur catenae longae microconidiorum. Holotypus: M. Stoner, Pomona, Calif., III.1977, CUP 58248.

Transfers of cultures derived from ascospores from the type collection are being deposited in the American Type Culture Collection and in the Centraalbureau voor Schimmelcultures, Baarn.

59. *Sclerotinia candolleana* (Lév.) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 330. 1870.
  ≡ *Peziza candolleana* Lév., Ann. Sci. Nat. Bot., Sér. 2, 20: 233. 1843.
  ≡ *CIBORINIA CANDOLLEANA* (Lév.) Whetzel, Mycologia 37: 668. 1945.

TYPICAL HOST: Leaves of *Castanea*.

60. *Sclerotinia caricis-ampullaceae* Nyberg, Meddeland. Soc. Fauna Fl. Fenn. 10: 22. 1933. (!!)
  ≡ *MYRIOSCLEROTINIA CARICIS-AMPULLACEAE* (Nyberg) Buchw., Friesia 3: 301. 1947.

TYPICAL HOST: *Carex ampullacea.*

SPECIMEN EXAMINED: W. Nyberg, VI.1931 [CUP 28912 (Isotype)].

61. *Sclerotinia carnea* Velen., Monogr. discomyc. Bohem. 1: 409. 1934. (!!)

TYPICAL HOST: Unknown: "in palude pratensi e limo excedens."

SPECIMEN EXAMINED: J. Velenovský, VI.1934 [PRM-Flora Bohemica 152975 (Holotype)].

NOTES: According to the diagnosis no sclerotia were collected attached to apothecia and the type specimen does not include sclerotia. The ectal excipulum of the apothecium is composed of clavate cells perpendicular to the apothecial surface; this is not a *Sclerotinia* sensu Kohn. Some stromatic cells at the base of the stipe suggest that this species may be Sclerotiniaceous, however.

62. *Sclerotinia carunculoides* Siegler & Jenkins, Science 55: 353. 1922. (!!) (!)
  ≡ *CIBORIA CARUNCULOIDES* (Siegler & Jenkins) Whetzel *in* Whetzel & Wolf, Mycologia 37: 484. 1945.

TYPICAL HOST: On fruits of cultivated *Morus alba* L.

SPECIMENS EXAMINED: Collector unknown, Mar.-Apr. 1924, fruits of *Morus alba* L., Washington, D.C. from sclerotia collected at Scranton, S.C. (CUP 34072); A.E. Jenkins, 3/27/23, seeds of *Morus alba* L., Scranton, S.C. [CUP 33598 (Authentic)]; Siegler, 4.1922, on *Morus alba* L., Scranton, S.C. [CUP 11810 (Holotype)].

NOTES: Korf *(pers. comm.)* agrees that his suggested assignment of this species to *Lanzia* (Korf, 1973) was premature and that *Ciboria* is the most appropriate generic disposition.

63. *Sclerotinia cassiopes* Rostr., Meddel. Grønland 18: 56. 1894. (!!)

TYPICAL HOST: On stromatized fruits of *Cassiope tetragona.*

SPECIMEN EXAMINED: N. Hartz, VI.1892 [C-Plantae groenlandicae 298, 299, 300 (Holotype)].

NOTES: The entire capsule is stromatized with much host tissue among the broad prosenchyma cells composing the stromal medulla. This is probably a *Monilinia* and should be compared with *Monilinia ledi* (Nawashin) Whetzel, also on Ericaceous fruits.

64. *Sclerotinia castaneae* Peyronel, Atti Reale Accad. Lincei, Rendiconti Cl. Sci. Fis., ser. 5, 29: 326. 21.XI.1920.

TYPICAL HOST: *Castanea.*

NOTES: Viennot-Bourgin (Les champignons parasites des plantes cultivées 1: 705. 1949) placed an anamorph of this species, *Rhacodiella castaneae* Peyronel, in synonymy under *Ciboria pseudotuberosa. Rhacodiella* is a synonym of *Myrioconium* and I am interpreting Viennot-Bourgin's transfer as indication that the teleomorph is also *C. pseudotuberosa.*

65. *Sclerotinia caudata* Velen., see *S. sclerotiorum* (No. 1 of this list).

66. *Sclerotinia cerasi* Woron., Mém. Acad. Imp. Sci. St. Pétersbourg, sér. 7, 36: 39. 1888.

TYPICAL HOST: Mummified fruits of *Prunus cerasus* L.

NOTES: This epithet is based on an anamorph. Whetzel (1945) considered this species to be a taxonomic synonym of *Monilinia laxa* (Aderh. & Ruhl.) Honey.

67. *Sclerotinia chaenomelis* Fischer, Schweiz. Obst-u. Gartenb.-Z. 13: 217. 1930.

TYPICAL HOST: *Cydonia japonica.*

NOTES: This epithet is based on an anamorph, *Monilia.*

68. *Sclerotinia ciborioides* (Fr. *ex* Fr.) Rehm, Ascomyceten *107*. 1872.

≡ [*Peziza ciborioides* Fr., Observ. mycol. 2: 307. 1818 (pre-starting point).]

≡ *Peziza ciborioides* Fr. *ex* Fr., Syst. mycol. 2(2): 117. 1822.

≡ *Peziza friesii* Pers., Mycol. eur. 1: 277. 1822 (a name change).

≡ *Ciboria ciborioides* (Fr. *ex* Fr.) Karst. [ut "*Rutstroemia ciborioides* (Fr.) Karst."], Hedwigia 27: 124. 1887.
≡ [*Rutstroemia ciborioides* (Fr. *ex* Fr.) Karst. [ut "(Fr.) Karst."], Hedwigia 27: 124. 1887, (*lapsus calami*).]
≡ *Ciboria friesii* (Pers.) Sacc. (ut "Pers."), Syll. fung. 8: 207. 1889.
≡ *Sclerotinia friesii* (Pers.) Boud., Hist. classific. discomyc. Europe p. 107. 1907.

TYPICAL HOST: Culms in a marsh.

NOTES: No clear concept of this species exists, and it may be "lost." Rehm misapplied it to *S. trifoliorum* when he issued it in 1872. The original description, "ad culmos in uliginosus," suggests that this may be a *Myriosclerotinia*. When Karsten (Hedwigia 27: 124. 1887) erected a new forma (f. *tenella*) of this species, he simultaneously transferred it to *Rutstroemia*, an egregious, unintentional error as can be seen by examining the footnote referring specifically to the generic name, where Karsten writes: "A *Ciboria* Fuck. sporis continuis, a *Sclerotinia* Fuck. sclerotio deficiente diversa." It is *Ciboria* that has continuous spores, and *Rutstroemia* that has septate spores, and by some abberration Karsten reversed the two. Since he clearly intended to refer this species and his new form to the non-septate-spored genus, I treat the combinations in *Rutstroemia* as errors that can be corrected. Holm (Trans. Brit. Mycol. Soc. 67: 334. 1976) did not recognize this as an abberration, and instead held that the footnote was "meant as an emendation of *Rutstroemia*," a position I cannot accept; it would equally have been an emendation of *Ciboria*.

69. *Sclerotinia cinerea* (Bon.) Schroet. *in* Cohn, Krypt.-Fl. Schlesien 3(2): 67. 1893.
≡ *MONILIA CINEREA* Bonorden, Handb. Mykol. p. 76, c.ic. - 78. 1851.

TYPICAL HOST: On fruits of *Prunus spinosa* and *P. domestica*.

NOTES: This epithet is based on an anamorph. Whetzel (1945) considered this species to be a synonym of *Monilinia laxa* (Aderh. & Ruhl.) Honey.

70. *Sclerotinia cinerea* Aderh. & Ruhl. [ut "(Bon.) Schroet."] Arbeiten Biol. Abt. Land- Forstwirtsch. Kaiserl. Gesundheitsamte 4: 435. 1905 (later homonym).

TYPICAL HOST: Decaying fruits of *Prunus cerasus, P. dulcis, P. persicus (?), P. domestica*.

NOTES: The teleomorph was first described here.

71. *Sclerotinia cinerea* Wormald [ut "(Bon.) Schroet."], Ann. Bot. 35: 134, c.ic. - pl. 6, 7. 1921 (later homonym).

TYPICAL HOST: Mummified fruits of "plum."

NOTES: Wormald described the teleomorph and considered *S. laxa* as a taxonomic synonym, as did Dennis (1956).

72. [*Sclerotinia cinerea* forma *avium* Harrison, J. Proc. R. Soc. N.S.W. 67: 156. 1933 *(nomen nudum)*.]

73. [*Sclerotinia cinerea* forma *cerasi* Harrison, J. Proc. R. Soc. N.S.W. 67: 156. 1933 *(nomen nudum)*.]

74. *Sclerotinia cinerea* forma *mali* (Wormald) Harrison, J. Proc. R. Soc. N.S.W. 67: 156. 1933.
≡ *MONILIA CINEREA* f. *MALI* Wormald, Ann. Bot. 34: 167. 1920.
≡ *Sclerotinia laxa* Aderh. & Ruhl. f. *mali* (Wormald) Harrison, J. Proc. R. Soc. N.S.W. 67: 172. 1933.

NOTES: Based on anamorphs.

75. *Sclerotinia cinerea* forma *pruni* (Wormald) Harrison, J. Proc. R. Soc. N.S.W. 67: 156. 1933.
≡ *MONILIA CINEREA* f. *PRUNI* Wormald, Ann. Bot. 34: 167. 1920.

NOTES: Based on anamorphs. Whetzel (1945) considered this to be a taxonomic synonym of *Monilinia laxa* (Aderh. & Ruhl.) Honey.

76. *Sclerotinia coloradensis* Cash & Davidson *in* Davidson & Cash, Mycologia 25: 268. 1933. (!!)

TYPICAL HOST: *Pedicularis groenlandica* Retz.

SPECIMEN EXAMINED: R.W. Davidson, July 7, 1930 [BPI-Davidson 525 (Holotype)].

NOTES: The sclerotia of this species are firmly attached to the host, old stems of *Pedicularis groenlandica*. The authors note that while incubating sclerotia a *Botrytis* anamorph was produced, but until conclusive cultural studies have been performed, assignment of this species to *Botryotinia* is premature.

77. *Sclerotinia confundens* Whetzel, Mycologia 32: 126. 1940 (a name change: illegitimate superfluous name).
≡ *Sclerotinia bifrons* Seaver & Shope, Mycologia 22: 1. 1930.
≡ *Ciborinia confundens* (Whetz.) Whetz., Mycologia 37: 668. 1945.
≡ *Ciborinia bifrons* (Seaver & Shope) Seaver [ut "(Ellis & Everh.) Seaver"), North Amer. Cup-Fungi (Inop.) p. 71. 1951 (later homonym).
≡ *CIBORINIA SEAVERI* Groves & Bowerman, Canad. J. Bot. 33: 581. 1955 (a name change).

TYPICAL HOST: On ground from free lying sclerotia entangled in leaf debris under trees of the Rocky Mountain form of *Populis tremuloides*.

NOTES: Groves and Bowerman (1955) point out that the name *S. confundens* Whetzel is illegitimate because it is an obligate synonym of *S. bifrons* Seaver & Shope and was nomenclaturally superfluous when proposed. *Ciborinia bifrons* (Ellis & Everh.) Seaver is an incorrect citation since the basionym is based on an anamorph, and is an illegitimate name because the combination in *Ciborinia* is preoccupied by *C. bifrons*

Whetzel (1945).

78. *Sclerotinia convoluta* Drayton, Mycologia 29: 314. 1937.
≡ *BOTRYOTINIA CONVOLUTA* (Drayton) Whetzel, Mycologia 37: 679. 1945.

TYPICAL HOST: Rhizomes of cultivated *Iris*.

79. *Sclerotinia corni* Reade, Ann. Mycol. 6: 113. 1908.
≡ *Monilinia corni* (Reade) Honey, Amer. J. Bot. 23: 105. 1936.

TYPICAL HOST: *Cornus circinata* L'Her.

NOTES: Reade's epithet is based upon an anamorph. I find no mention of apothecia in Honey's paper either.

80. *Sclerotinia corni* Vaček, Stud. Bot. Čech. 11: 72. 1950 (later homonym). (!!)

TYPICAL HOST: On seeds of *Cornus mas*.

SPECIMEN EXAMINED: V. Vaček, 25/IX.1949 [PRM-Flora bohemica 173830 (Holotype)].

NOTES: The stroma, on seeds of *Cornus mas*, is composed of a loose weft of brown-walled prosenchyma, poorly differentiated into rind and medulla and appears to mantle only the surface of the seed with little penetration. This species may be referable to *Lanzia* or *Lambertella*.

81. *Sclerotinia coryli* Schell. Ber. Deutsch. Bot. Ges. 24: 505, c.ic. - XXI. 1906.
≡ *CIBORIA CORYLI* (Schell.) Buchw., Tidsskr. Planteavl 47: 537. 1943.

TYPICAL HOST: On fruits of *Corylus avellana*.

82. *Sclerotinia crategi* Magnus, Ber. Deutsch. Bot. Ges. 23: 197, c.ic. - V. 1905.

TYPICAL HOST: Stromatized fruits of *Crataegus*.

NOTES: Whetzel (1945) considered this species to be a taxonomic synonym of *Monilinia johnsonii* (Ell. & Everh.) Honey.

83. [*Sclerotinia culmifida* Jørstad, Rev. Appl. Mycol. 4: 17. 1925; Rev. Appl. Mycol. Index to Vol. 1-40 (1922-1961): 748. 1968, *lapsus calami* for *Septoria culmifida*.]

84. *Sclerotinia curreyana* (Berk. *in* Currey) Karsten, Acta Soc. Fauna Fl. Fenn. 2(6): 123. 1885.
≡ *Peziza curreyana* Berk. *in* Currey, J. Linn. Soc., Bot. 1: 147. 1857.
≡ [*Peziza curreyi* Berk., Outl. Brit. fungol. p. 370. 1860 *(lapsus calami)*.]
≡ *MYRIOSCLEROTINIA CURREYANA* (Berk. *in* Currey) Buchw., Friesia 3: 291. 1947.

TYPICAL HOST: On previous year's stems of *Juncus conglomeratus*.

85. *Sclerotinia cydoniae* Schell. [Ber. Deutsch. Bot. Ges. 6: 207. 1899 (nomen nudum)] Centralbl. Bakteriol., 2 Abth., 17: 189. 1907 (illegitimate: superfluous name).
≡ *Ciboria linhartiana* Prill. & Delacr., Bull. Soc. Mycol. Fr. 9: 198. 1893 [ut "*Ciboria (Stromatinia) Linhartiana,*" pp. 198, 199; ut "*Peziza (Stromatinia Linhartiana)*" p. 198 *(lapsus calami);* ut "*Stromatinia Linhartiana*" p. xi (index) *(lapsus calami)*].
≡ *Monilinia cydoniae* (Schell.) Whetzel, Mycologia 37: 672. 1945.
≡ *MONILINIA LINHARTIANA* (Prill. & Delacr.) Buchw., Aarskr. Kgl. Veterinaer- of Landbohøjskoles 32: 168. 1949.

TYPICAL HOST: Mummified fruits of *Cydonia vulgaris* Pers.

NOTES: Schellenberg (Ber. Deutsch. Bot. Ges. 6: 207. 1899) reasoned that since *Monilia linhartiana* Sacc. occurs on cherries, and not quince, Prilleaux and Delacroix's name was inapplicable to the species on quince, and proposed a new (superfluous) name for it.

86. *Sclerotinia cylindrica* Velen., Monogr. discomyc. Bohem. 1: 224; 2: XXII(39). 1934. (!!)

TYPICAL HOST: Near grass.

SPECIMEN EXAMINED: J. Velenovský, V.1927 [PRM-Flora bohemica 154021 (Holotype)].

NOTES: This is probably a species of *Ciborinia;* the sclerotial medulla is full of host tissue. Host data is unfortunately vague ("ad gramino").

87. [*Sclerotinia demissa* Dana, Phytopathology 11: 228. 1921 (*nomen nudum*).]
≡ [*Monilinia demissa* (Dana) Honey, Amer. J. Bot. 23: 105. 1936 (*nomen nudum*).]

TYPICAL HOST: Leaves, twigs and mummified fruits of *Prunus demissa.*

88. *Sclerotinia dennisii* Svrček, Česká Mykol. 15: 37. I.1961.
≡ *MYRIOSCLEROTINIA DENNISII* (Svrček) Schwegler, Schweiz. Z. Pilzk. 56: 53. 1978.

TYPICAL HOST: In dead, partially immersed culms of *Eriophorum vaginatum.*

89. *Sclerotinia douglasii* (Tubeuf) Massee, Textbook of plant diseases p. 382. 1899.
≡ *BOTRYTIS DOUGLASII* Tubeuf, Beitr. z. Baumkr. p. 4, c.ic. - I. 1888.

TYPICAL HOST: On living leaves and youngest internodes of seedling *Abies douglasii* and *Sequoia gigantea.*

NOTES: This epithet is based on an anamorph.

90. *Sclerotinia draytonii* Buddin & Wakefield (ut "*draytoni*"), Trans. Brit. Mycol. Soc. 29: 150. 1946.
≡ *BOTRYOTINIA DRAYTONII* (Buddin & Wakefield) Seaver (ut "*draytoni*"), North Amer. Cup-Fungi (Inop.) p. 62. 1951.

TYPICAL HOST: Stems of a cultivated *Gladiolus*.

91. *Sclerotinia duriaeana* (Tul. & Tul.) Rehm [forma *duriaeana*] Hedwigia 21: 66. 1882.
    - ≡ *Peziza duriaeana* Tul. & Tul., Sel. fung. carp. 1: 103. 1861.
    - ≡ *Sclerotinia duriaeana* f. *ambiens* (Desm.) Whetzel, Mycologia 21: 6. 1929 (illegitimate: based on *Epidochium ambiens* Desm., Ann. Sci. Nat. sér. 3, 20: 231. 1853, but superfluous, included the type of *Peziza duriaeana*).
    - ≡ *MYRIOSCLEROTINIA DURIAEANA* (Tul. & Tul.) Buchw., Friesia 3: 299. 1947.

TYPICAL HOST: *Carex arenaria*.

92. *Sclerotinia duriaeana* (Tul. & Tul.) Rehm forma *affine* (Desm.) Whetzel, Mycologia 21: 6. 1929.
    - ≡ *Epidochium affine* Desm., Ann. Sci. Nat. sér. 3, 20: 232. 1853.

TYPICAL HOST: *Carex* (? *hudsonii* Bennett fide Whetzel).

NOTES: This is based on anamorphs. According to Whetzel (1946) this is a taxonomic synonym of *S. sulcata*.

93. *Sclerotinia duriaeana* (Tul. & Tul.) Rehm forma *ambiens* (Desm.) Whetzel, see *S. duriaeana* f. *duriaeana*, No. 91 of this list.

NOTES: According to Whetzel (1946) this is "what Tulasne had in hand" for *S. duriaeana*.

94. *Sclerotinia echinophila* (Bull. *ex* Fr.) Rehm *in* Rabenh., Krypt.-Fl. Deutschl. II, 1(3): 813. 1893.
    - ≡ [*Peziza echinophila* Bull., Hist. champ. France p. 235, c.ic. - 500(1). 1791 (pre-starting point).]
    - ≡ *Peziza echinophila* Bull. *ex* Fr., Syst. mycol. 2(1): 118. 1822.
    - ≡ *Rutstroemia echinophila* (Bull. *ex* Fr.) Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. I, 126: 340. 1917.

TYPICAL HOST: Involucres of *Castanea vesca*.

NOTES: According to Korf *(pers. comm.)* this is a species of *Lanzia*.

95. *Sclerotinia eleocharidis* Henderson, Notes Roy. Bot. Gard. Edinburgh 30: 204. 4.VI.1970. (!!)

TYPICAL HOST: Dead culms of *Eleocharis palustris*.

SPECIMEN EXAMINED: Henderson, 1 VI 69 [E-Henderson 9408 (Holotype)].

NOTES: This is definitely a *Myriosclerotinia* and despite the host, *Eleocharis palustris*, may be a synonym of "*M. sulcata*," No. 236 of this list.

96. *Sclerotinia empetri* Lagerh. *in* Vestergr. (ut "*empetri* f. *sclerotifera*"), Bot. Not. 1899: 163. 1899.

≡ *MONILINIA EMPETRI* (Lagerh. *in* Vestergr.) B. Erikss., Symb. Bot. Upsal. 19: 46. 1970.

TYPICAL HOST: Mummified berries of *Empetrum nigrum.*

NOTES: Lagerheim's description was published in the listings of Vestergren's exsiccatum. While Lagerheim apparently saw immature apothecia, which were described, the specimens issued in the exsiccatum probably included only anamorphic material, as indicated by the "f. *sclerotifera*" of the original description. B. Eriksson *(loc. cit.)* noted that the UPS material of Vestergren, Micr. rar. sel. *56* includes only sclerotia but that Lagerheim saw very young apothecia. She provided a description of mature apothecia. The conidial state is unknown for this species.

97. [*Sclerotinia eriophori* Whetzel *in* Buchw., Friesia 3: 303. 1947, *nom. nud.*]

98. *Sclerotinia erythronii* Whetzel, Mycologia 18: 232. 1926.
≡ *CIBORINIA ERYTHRONII* (Whetzel) Whetzel, Mycologia 37: 668. 1945.

TYPICAL HOST: *Erythronium americanum* Ker.

99. *Sclerotinia fallax* Cash & Davidson *in* Davidson & Cash [ut "(Sacc.?) Cash & Davidson"], Mycologia 25: 270. 1933. (!!)

TYPICAL HOST: *Potentilla* sp.

SPECIMEN EXAMINED: R.W. Davidson, July 1, 1930 [BPI-Davidson 476 (Holotype)].

NOTES: Cash and Davidson *(loc. cit.)* considered *Sclerotium fallax* Sacc. to be a probable synonym of their species since both occurred on *Potentilla*, but they could not obtain type or authentic material of Saccardo's so that the citation of Saccardo's epithet carried a question mark. Their citation is incorrect in any case becaused the questioned basionym is based on an anamorph. The type specimen of *Sclerotinia fallax* contains subpackets with the actual type specimen probably the subpacket containing apothecia with 4-spored asci, as described in the diagnosis, and not the subpacket containing apothecia with 8-spored asci, which are not mentioned in the diagnosis. Both types of apothecia appear to be conspecific based on other characters. The sclerotia are attached to host tissue; this is either a *Botryotinia* or a *Ciborinia*.

100. *Sclerotinia festucae* Velen., Monogr. discomyc. Bohem. 1: 224; 2: XXIII(42). 1934. (!!)

TYPICAL HOST: In leaves of *Festuca gigantea* Vill.

SPECIMEN EXAMINED: J. Velenovský, 27.V.1931 [PRM-Flora bohemica 154020 (Holotype)].

NOTES: This is a *Myriosclerotinia*, with sclerotia developing within the culms of a gramineous host. The ascospores are smaller than those of *M. borealis* (Bub. & Vleug. *in* Vleug.) Kohn.

101. [*Sclerotinia ficariacearum* Whetzel *in* Buchw., Aarskr. Kgl. Veterinaer- og Landbohøjskoles 32: 134. 1949, *nom. nud.*]
   = *BOTRYOTINIA FICARIARUM* Hennebert *in* Hennebert & Groves, Canad. J. Bot. 41: 355. 1963.

TYPICAL HOST: *Ficaria verna.*

102. *Sclerotinia ficariae* Rehm *in* Rabenhorst, see *S. sclerotiorum,* No. 1 of this list.

103. *Sclerotinia foliicola* Cash & Davidson *in* Davidson & Cash, Mycologia 25: 269. 1933.
   ≡ *CIBORINIA FOLIICOLA* (Cash & Davidson *in* Davidson & Cash) Whetzel, Mycologia 37: 668. 1945.

TYPICAL HOST: *Salix* sp.

104. *Sclerotinia fredericae* Svrček, Česká Mykol. 20: 16. 15.I. 1966. (!!)

TYPICAL HOST: Within leaves of *Carlina acaulis.*

SPECIMEN EXAMINED: Bedřiška Hřebíková, 6.X.1958 [PRM-Flora slovaca 731952 (Holotype)].

NOTES: This is probably a species of *Poculum.* The stroma developing within the leaves of *Carlina acaulis* is composed of a medulla of interwoven prosenchyma with a poorly developed rind. The ectal excipulum of the apothecium is of hyaline textura oblita with abundant brown-walled tomentum hyphae. The fusoid to allantoid ascospores are hyaline.

105. *Sclerotinia friesii* (Pers.) Boud., see *S. ciborioides,* No. 68 of this list.

106. *Sclerotinia fructicola* (Winter) Rehm *in* Sacc., Syll. fung. 18: 41. 1906.
   ≡ *Ciboria fructicola* Winter, Hedwigia 22: 131. 1883.
   ≡ *MONILINIA FRUCTICOLA* (Winter) Honey, Mycologia 20: 153. 1928.

TYPICAL HOST: Rotting fruits of *Persica vulgaris (Prunus persica).*

107. *Sclerotinia fructigena* (Pers. *ex* Pers.) Schroet. *in* Cohn, Krypt.-Fl. Schlesien 3(2): 67. 1893.
   ≡ [*Torula fructigena* Pers., Ann. Bot. (Usteri) 15: 26. 1795 (pre-starting point).]
   ≡ [*Monilia fructigena* (Pers.) Pers., Syn. meth. fung. p. 693. 1801 (pre-starting point).]
   ≡ *Acrosporium fructigenum* (Pers.) *ex* Pers., Mycol. eur. 1: 24. 1822 (before 28.III.1822).
   ≡ *MONILIA FRUCTIGENA* (Pers. *ex* Pers.) Eaton, Man. bot., Ed. 3, p. 357. 1822 (23.III - 23.IV.1822).

TYPICAL HOST: Rotting fruits of *Pyrus communis, Prunus* spp.

NOTES: This epithet is based on an anamorph. The epithet "*fructigena*" has been applied to various teleomorphic fungi (see next three entries), but is preoccupied in *Sclerotinia* by the Schroeter combination. It can be used in *Monilinia,* however (see No. 108, below).

108. *Sclerotinia fructigena* Aderh. *ex* Sacc. & Sacc. *in* Sacc., Syll. fung. 18: 41. 1906 (later homonym).
 ?= [*Monilinia fructigena* Honey, Amer. J. Bot. 23: 102. 1936 *(nom. nud.)*.]
 ≡ *MONILINIA FRUCTIGENA* Honey *in* Whetzel [ut "(Aderh. & Ruhl.) Honey"], Mycologia 37: 672. 1945.

TYPICAL HOST: Fruits of *Pyrus malus* and *P. communis*.

NOTES: This is a later homonym of *S. fructigena* (Pers.) Schroet., and is based on the description of apothecia by Aderhold (1904). Most recent authors cite the name as *S. fructigena* Aderh. & Ruhl., based on the later paper by Aderhold and Ruhland (1905). In both papers, however, the authors used "(Pers.) Schroet." as the authorities, and Saccardo was apparently the first to attempt to treat the teleomorphic material with Aderhold's name as authority. The epithet "*fructigena*" took on new life in *Monilinia* when Honey's name was provided with a reference to a previously and validly published Latin diagnosis of the teleomorph [as *Sclerotinia fructigena* (Pers.) Schroet.]. There is no valid name for the species in the genus *Sclerotinia*, however.

109. *Sclerotinia fructigena* Norton *ex* Sacc. & Sacc. *in* Sacc. [ut "(Schr.?) Norton"], Syll. fung. 18: 40. 1906 (later homonym).

TYPICAL HOST: Fruits of *Amygdalis* and *Prunus*.

NOTES: This is another intentional homonym created by Saccardo and Saccardo, based on American apothecial material and therefore differing from "*S. fructigena* Aderh. *ex* Sacc. & Sacc.," and from "*S. fructigena* (Woron.) Norton *ex* Sacc. & Sacc.," both apparently based on European material.

110. *Sclerotinia fructigena* (Woron.) Norton *ex* Sacc. & Sacc. *in* Sacc., Syll. fung. 18: 41. 1906.

TYPICAL HOST: Pomaceous fruits.

NOTES: This is another intentional later homonym created by Saccardo and Saccardo, purporting to be a name for the pomaceous brown rot fungus described by Woronin (from conidia), which thus differs from "*S. fructigena* Norton *ex* Sacc. & Sacc." on stone fruits in America and from "*S. fructigena* Aderh. *ex* Sacc. & Sacc.," an apparently different European species on stone fruits.

111. *Sclerotinia fuckeliana* (de Bary) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23-24: 330. 1870.
 ≡ *Peziza fuckeliana* de Bary, Morphol. Phys. Pilze p. 30. 1866.
 ≡ *BOTRYOTINIA FUCKELIANA* (de Bary) Whetzel, Mycologia 37: 679. 1945.

TYPICAL HOST: Fallen leaves and rarely fruits of *Vitis vinifera*.

112. *Sclerotinia galanthi* Ludw., Lehrb. d. nied. Krypt. p. 355. 1892.

TYPICAL HOST: Snowdrop (*Galanthus* sp.).

NOTES: This epithet is based on anamorphs. A *Botrytis* anamorph is mentioned in the description and Buchwald (1949) suggests that the species observed by Ludwig is identical with *Botrytis galanthina* (Berk. & Br.) Sacc. Buchwald incorrectly (under today's International Code of Botanical Nomenclature) considered Ludwig's name to be a *nomen nudum*.

113. *Sclerotinia galanthi* Keissler (ut "Ludw."), Zeit. Gärungsphysiol. 6: 24. 1917 (later homonym).

TYPICAL HOST: Snowdrop (*Galanthus* sp.).

NOTES: Keissler described the apothecial teleomorph of *S. galanthi* Ludw. Buchwald (1949) cites Keissler as the author, but Ludwig's name, based on anamorphs, has priority in *Sclerotinia*.

114. *Sclerotinia galeopsidis* Velen., see *S. sclerotiorum*, No. 1 of this list.

115. *Sclerotinia geranii* Seaver & Horne, Mem. Torrey Bot. Club 17: 205. 1918.
≡ *SEAVERINIA GERANII* (Seaver & Horne) Whetzel, Mycologia 37: 705. 1945.

TYPICAL HOST: Rhizomes of *Geranium maculatum* L.

NOTES: The anamorph is *Verrucobotrys geranii* (Seaver) Hennebert (Hennebert, 1973).

116. *Sclerotinia gladioli* Drayton [ut "(Massey) Drayton"], Phytopathology 24: 400. 1934.
≡ *STROMATINIA GLADIOLI* (Drayton) Whetzel, Mycologia 37: 674. 1945.

TYPICAL HOST: On *Gladiolus* sp.

NOTES: Since *Sclerotium gladioli* Massee is based on an anamorph, the epithet dates from 1934 for the teleomorph.

117. *Sclerotinia glandicola* Velen., Nov. mycol. p. 129. 1947. (!!)

TYPICAL HOST: Unknown, "near rotting acorns."

SPECIMEN EXAMINED: V. Vaček, IX.1941 [PRM-Flora moravici 154019 (Holotype)].

NOTES: This is a *Ciborinia*.

118. *Sclerotinia globispora* Velen., Monogr. discomyc. Bohem. 1: 227; 2: XXX(29-31). 1934. (!!)

TYPICAL HOST: In a garden among clumps of *Campanula carpatica* Jacq.

SPECIMEN EXAMINED: J. Velenovský, 6.IV.1932 [PRM-Flora bohemica 152950 (Holotype)].

NOTES: No sclerotia were present in the poorly preserved type specimen and there is no mention of the location of sclerotia in the diagnosis. The ectal excipulum of the apothecium is composed of brick-shaped cells oriented with the long axis parallel to the apothecial surface. This may belong in *Lambertella* or *Lanzia*.

119. *Sclerotinia globosa* (Buchw.) Webster, Trans. Brit. Mycol. Soc. 37: 168. 1954.
≡ *BOTRYOTINIA GLOBOSA* Buchw., Phytopath. Z. 20: 250. 1953.

TYPICAL HOST: *Allium ursinum.*

120. *Sclerotinia gracilipes* (Cooke) Sacc., Syll. fung. 8: 200. 1889.
≡ *Peziza gracilipes* Cooke, Hedwigia 14: 82. 1875; Bull. Buffalo Soc. Nat. Sci. 1: 294. 1875.
≡ *CIBORINIA GRACILIPES* (Cooke) Seaver, North Amer. Cup-Fungi (Inop.) p. 72. 1951.

TYPICAL HOST: On petioles of *Magnolia glauca.*

121. *Sclerotinia gracilis* Clements *in* Bessey, Contrib. Bot. Dept. Univ. Nebr. n.s. 3: 47. 1892.
≡ *CIBORINIA GRACILIS* (Clements *in* Bessey) Whetzel, Mycologia 37: 668. 1945.

TYPICAL HOST: Possibly associated with *Erythronium albidum.*

122. *Sclerotinia graminearum* Elenev. *ex* Solkina, Zašč. Rast. 18: 107. 1938.

TYPICAL HOST: *Triticum vulgare* Vill. and *Secale cereale* L.

NOTES: On the basis of the diagnosis I consider this species to be a taxonomic synonym of *Myriosclerotinia borealis* (Bub. & Vleug. *in* Vleug.) Kohn, No. 53 of this list. I have been advised by Dr. S. P. Wasser of the Bot. Akad. Sci. Inst. of Ukranian S.S.R. that the type specimen has not been preserved.

123. *Sclerotinia granigena* (Quél.) Sacc., Syll. fung. 8: 198. 1889.
≡ *Phialea granigena* Quél., C.R. Ass. franç. Av. Sci. (La Rochelle, 1882) 11: 407, c.ic. - XII(7). 1883.
≡ *GLOEOTINIA GRANIGENA* (Quél.) Schum., Mycotaxon 8: 125. 1979.

TYPICAL HOST: Stromatized seeds of *Bromus erectus.*

NOTES: This is a *Gloeotinia* and, as Schumacher (1979) has shown, provides the correct epithet for *G. temulenta.*

124. [*Sclerotinia gregaria* Dana, Phytopathology 11: 106. 1921 (*nomen nudum*).]
≡ [*Monilinia gregaria* (Dana) Honey, Amer. J. Bot. 23: 105. 1939 (*nomen nudum*).]

TYPICAL HOST: *Amelanchier cusickii.*

125. *Sclerotinia gregoriana* J.T. Palmer, Acta Mycol. 4: 231. 1968. (!!)

TYPICAL HOST: Culms of *Scirpus caespitosus* L.

SPECIMEN EXAMINED: J.T. Palmer, 19.VI.1966 [CUP 48892 *ex* J.T. Palmer Herb. 3010 (Isotype)].

NOTES: This is a *Myriosclerotinia,* perhaps a synonym of *M. scirpicola* (Rehm *in* Rabenh.) Buchw. The sclerotium is produced within the culms of *Scirpus,* the developing sclerotium is pink, the allantoid spores are slightly narrower than those of *M. scirpicola,* and there is a covering layer of prosenchyma over the ectal excipulum of the apothecium.

126. *Sclerotinia hartii* (Berk.) Boud., Hist. classific. discomyc. Europe p. 108. 1907.
≡ *Urnula hartii* Berk., J. Linn. Soc. 17: 13. 31.VII.1878. (!!)

TYPICAL HOST: On moss.

SPECIMEN EXAMINED: H.C. Hart, July, 1875 [K (Holotype)].

NOTES: Since no stromatal tissue was included with the portion of the type specimen loaned and all zones of the apothecium are composed of parallel, prosenchymatous cells, this is not a *Sclerotinia* but I cannot determine whether or not it is referrable to the Sclerotiniaceae. Boudier included this species in *Sclerotinia* as a doubtful species.

127. *Sclerotinia henningsiana* Kirschst., see *S. sclerotiorum,* No. 1 of this list.

128. *Sclerotinia herbiseda* Velen., Novit. mycol. p. 189. 1939. (!!)

TYPICAL HOST: Withered leaves of *Cirsium.*

SPECIMEN EXAMINED: J. Velenovský, VII.1938 [PRM-Flora bohemica 152962 (Holotype)].

NOTES: This is a *Lambertella,* close to *L. viburni,* but with granularly roughened tomentum hyphae.

129. [*Sclerotinia heterocarpa* Whetzel, Farlowia 2: 436. 1946, *lapsus calami* for *S. homoeocarpa.*]

130. [*Sclerotinia heteroeca* Woronin & Nawaschin *in* Rehm, Ber. Bayer. Bot. Ges. 15: 237, 1915, *lapsus calami* for *S. heteroica.*]

131. *Sclerotinia heteroica* Woronin & Nawaschin, Ber. Deutsch. Bot. Ges. 12: 187. 1894.

TYPICAL HOST: *Ledum palustre.*

NOTES: This epithet is based on anamorphs. Whetzel (1945) considered it to be a synonym of *Monilinia ledi* (Nawaschin) Whetzel.

132. *Sclerotinia hiemalis* (Bernst.) Fuckel [ut "*hyemalis* (Milde) Fuckel"], Jahrb. Nassauischen Vereins Naturk. 27-28:

65. 1873.
≡ *Microstoma hiemalis* Bernst., Nova Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. 23: 649. 1852.

TYPICAL HOST: In soil.

NOTES: This is a synonym of *Microstoma protracta* (Fr.) Kanouse. The confusion over whether to cite Bernstein, Nees & Bernstein, or Milde as the authority for *M. hiemalis* has been cleared up by Kanouse (1948). It occurs on buried sticks and roots, but the connection to these was not seen by Bernstein *(loc. cit.)* nor by Fuckel *(loc. cit.)*. Fuckel assumed a sclerotium would be found both in 1873 when he synonymized this with *S. baccata* (No. 48 of this list) and when he originally described that species (Fuckel, 1870).

133. *Sclerotinia hirtella* Boud., Hist. classific. discomyc. Europe p. 107. 1907.
≡ *Sclerotinia candolleana* var. *hirtella* (Boud.) Rehm (ut "*hirtellum* Boud."), Ber. Bayer. Bot. Ges. 15: 241. 1915.
≡ *CIBORINIA HIRTELLA* (Boud.) Batra & Korf, Amer. J. Bot. 46: 448. 1959.

TYPICAL HOST: Leaves and branches of *Castanea*.

134. *Sclerotinia homoeocarpa* Bennett, Ann. Appl. Biol. 24: 255. V.1937.

TYPICAL HOST: Causing "dollarspot" disease in fine turf on *Festuca, Agrostis, Poa*.

NOTES: This name has no existing type specimen. The epithet has been applied to species identified by Korf *(pers. comm.)* as belonging to *Lanzia* and to *Moellerodiscus*.

135. *Sclerotinia hordei* Schell., Centralbl. Bakteriol. 2 Abth. 12: 735. 3.IX.1904.

TYPICAL HOST: Foot and stem base of *Hordeum*.

NOTES: This is probably a *Botryotinia* since Schellenberg described a *Botrytis* anamorph.

136. *Sclerotinia hyemalis* (Milde) Fuckel, see *S. hiemalis*, No. 132 of this list.

137. *Sclerotinia incondita* (Ellis) Sacc., Syll. fung. 8: 200. 1889.
≡ *Peziza incondita* Ellis, Bull. Torrey Bot. Club 8: 73. VII.1881. (!!)

TYPICAL HOST: Among moss.

SPECIMEN EXAMINED: Ellis, North Amer. Fungi *391* [CUP-Durand 102-54 (Isotype)].

NOTES: This is probably a *Ciborinia*. The asci are tetrasporous.

138. *Sclerotinia infundibuliformis* Peck, see *Dumontinia tuberosa*, No. 244 of this list.

139. *Sclerotinia intermedia* Ramsey, see *S. minor*, No. 2 of this list.

140. *Sclerotinia johnsonii* (Ellis & Everh.) Rehm, Ann. Mycol. 4: 338. 1906.
  ≡ *Ciboria johnsonii* Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia 46: 348. 11.XII.1894.
  ≡ *MONILINIA JOHNSONII* (Ellis & Everh.) Honey, Amer. J. Bot. 23. 105. 1936.

TYPICAL HOST: On decaying thorn apples *(Crataegus)* lying on the ground.

141. *Sclerotinia juglandis* (Preuss) Rehm *in* Rabenh., Krypt.-Fl. Deutschl. II 1(3): 810. 1893.
  ≡ *Peziza juglandis* Preuss, Linnaea 24: 146. 1851.
  ≡ *Ciboria juglandis* (Preuss) Sacc., Syll. fung. 8: 201. 1889.

TYPICAL HOST: Fallen cotyledons of *Juglans*.

NOTES: From the description, this species produces a substratal stroma.

142. *Sclerotinia juncifida* (Nyl.) J.T. Palmer, Irish Naturalists' J. 16: 263. I.1970.
  ≡ *Peziza juncifida* Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 10: 39. 1869.
  ≡ *MYRIOSCLEROTINIA JUNCIFIDA* (Nyl.) J.T. Palmer, Friesia 9: 199. 1969.

TYPICAL HOST: On culms of *Juncus (? compressus* L.).

NOTES: I refer this epithet to *Myriosclerotinia*. Palmer apparently revised his concept of *Sclerotinia* to include *Myriosclerotinia*.

143. *Sclerotinia juncigena* (Ellis & Everh.) Whetzel, Farlowia 2: 432. 1946.
  ≡ *Ciboria juncigena* Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia 46: 348. 11.XII.1894. (!!)

TYPICAL HOST: On dead stems of *Juncus*.

SPECIMEN EXAMINED: W.N. Suksdorf, 31.V.1883 [CUP-Durand 78-49, Suksdorf *371* (Isotype)].

NOTES: I concur with J.T. Palmer who annotated this specimen as *Myriosclerotinia curreyana* (Berk. *in* Currey) Buchw. Whetzel (1946) writes of this species, "It is unquestionably very closely related to *S. curreyana* and may indeed be more properly regarded as an American form or variety of that species."

144. [*Sclerotinia kenjiana* Miura, Bull. Agr. Exp. Sta. South Manchuria Railway Company (Minamimanshu Tetsudokabushiki Kaisha Noji-Shiken-Jo Iho) 18: 77. 1925, *nom. provis.*]

145. *Sclerotinia kerneri* (Wettst.) Sacc. (ut "Wettst."), Syll. fung. 8: 197. 1889.
  ≡ *Peziza (Sclerotinia) kerneri* Wettst., Sitzungsb. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 94: 72, c.ic. - II. 1887. (!)

TYPICAL HOST: Male flowers of *Abies (? pectinata).*

SPECIMENS EXAMINED: Wettstein, Austria infer!, Sparbach [S-Sydow (Topotype, possibly Isotype)]; Wettstein, Austria inferior, *Abies alba* Mill., Flora Exsicc. Austro-Hungarica *3175* (Topotype, possibly Isotype) CUP, FH, W; L.H. Wright and R. Cauchon, 22. Oct-30 Nov. 1971, New Richmond, Quebec (DAOM 149538).

NOTES: The paraphyses are inflated at the apices and immersed in gel to form a pseudoepithecium. The ascus pore channel wall is J-, as noted by Elliott (1976), but with KOH pretreatment (see Kohn & Korf, 1975) becomes strongly J+. The inner zone of the ectal excipulum which Elliott describes as "closely compacted" is bound in gel and turns blue in Melzer's Reagent. The roughening of the ectal excipular cells in both the apothecium and stipe is in bands, unlike that observed in other species of sclerotium-forming Sclerotiniaceae. The ectal excipulum of the apothecium is of textura porrecta oriented parallel to the apothecial surface. The sclerotial rind is composed of a layer of inflated to globose cells, 2-3 cells deep, with the outer walls of the outermost cells thicker and more heavily melanized than the other walls. The sclerotial medulla includes host tissue and the sclerotium is firmly attached to the host.

These features, especially the morphology both of the ectal excipulum of the apothecium and of the sclerotium, preclude assignment to any described genus in the Sclerotiniaceae. I therefore accommodate this species in a new genus.

ELLIOTTINIA Kohn, *gen. nov.*

Sclerotia ad hospitem firme affixa, medulla substantiam hospitis includente, praecipue prope situm ubi ad hospitem affixa. Apothecia stipitata, cupulata, sclerotiis portata. Excipulum ectale ex textura porrecta formatum, ad superficiem apothecialem parallelum. A *Sclerotinia* et *Ciborinia* differens in absentia cellularum globosarum ab exciplo ectali apothecii et a generibus Sclerotiniacearum aliis in absentia status conidialis et in formatione sclerotiorum verorum. Species typica: *Peziza (Sclerotinia) kerneri* Wettst.

Sclerotia firmly attached to the host, medulla incorporating host tissue, especially near the site of attachment to the host. *Apothecia* stipitate, cupulate, borne on sclerotia. Ectal excipulum of textura porrecta, parallel to the apothecial surface. Differing from *Sclerotinia* and *Ciborinia* in the absence of globose cells in the ectal excipulum of the apothecium, and from other genera in the Sclerotiniaceae in the absence of a conidial state and the formation of true sclerotia. Holotype species: ELLIOTTINIA KERNERI (Wettst.) Kohn, *comb. nov.* [basionym: *Peziza (Sclerotinia) kerneri* Wettst., Sitzungsb. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Cl., Abt. 1, 94: 72. 1887.

Etymology: Named for the late Mary E. Elliott, a diligent and helpful colleague in studies in the Sclerotiniaceae.

146. *Sclerotinia kusanoi* P. Henn. *ex* Takahashi, Miyabe-Festschrift or a Collection of Botanical Papers p. 142. 1911.
≡ *MONILINIA KUSANOI* (P. Henn. *ex* Takahashi) Yamamoto [ut "(P. Henn.)"], Trans. Mycol. Soc. Japan 2(2): 3. 1959.

TYPICAL HOST: Mummified fruits of *Prunus pseudocerasus*.

NOTES: The anamorph is *Monilia kusanoi* P. Henn., Bot. Jahrb. 32: 45. 1903. Takahashi credited the teleomorph, for which he provided the description, to Hennings.

147. *Sclerotinia laxa* Aderh. & Ruhl. [ut "(Ehrenb.) Aderh. & Ruhl."], Arbeit. Biol. Abt. Land- und Forstwirtsch. Kaiserl. Gesundheitsamte 4: 435, c.ic. - pl. 7. 1905.
≡ [*Monilinia laxa* Honey, Amer. J. Bot. 23: 102. 1936, *nom. nud.*]
≡ *MONILINIA LAXA* (Aderh. & Ruhl.) Honey *in* Whetzel, Mycologia 37: 672. 1945.

TYPICAL HOST: Rotted fruits of *Prunus armeniaceae* L.

NOTES: Although Aderhold & Ruhland described the teleomorph, they transferred the anamorphic name, *Oidium laxum* Ehrenb. *ex* Fr.

148. *Sclerotinia laxa* forma *mali* (Wormald) Harrison, see *S. cinerea* f. *mali*, No. 74 of this list.

149. *Sclerotinia ledi* Nawaschin, Ber. Deutsch. Bot. Ges. 12: 117. 1894.
≡ *MONILINIA LEDI* (Nawaschin) Whetzel, Mycologia 37: 673. 1945.

TYPICAL HOST: Anamorph on *Vaccinium*, teleomorph produced on *Ledum*.

150. *Sclerotinia lentiformis* Velen., České Houby, Dil. IV-V, p. 852. 1922. (!!)

TYPICAL HOST: Lens-shaped galls on leaves of *Quercus* and *Fagus*.

SPECIMEN EXAMINED: J. Šimr, III.1921 [PRM-Flora bohemica 149721 (Holotype)].

NOTES: This is probably a *Ciboria;* the apothecia of the type collection are very badly preserved.

151. [*Sclerotinia levi* Nawaschin *in* Rehm, Ber. Bayer. Bot. Ges. 15: 237. 1915, *lapsus calami* for *S. ledi*.]

152. *Sclerotinia libertiana* Fuckel, see *S. sclerotiorum*, No. 1 of this list.

153. *Sclerotinia lindaviana* Kirschst. *in* Rehm, Ascom. Exsicc. *1604*. 1905; Verh. Bot. Vereins Prov. Brandenburg 48: 42. 1906.
≡ *Rutstroemia lindaviana* (Kirschst.) Dennis, British cup fungi p. 65. 1960.

TYPICAL HOST: Wet, decayed leaves of *Phragmites communis*.

NOTES: The substratal stroma clearly excludes the species from *Sclerotinia*.

154. *Sclerotinia longisclerotialis* Whetzel, Mycologia 21: 24. 1929. (!!)

≡ *MYRIOSCLEROTINIA LONGISCLEROTIALIS* (Whetzel) Buchw., Kgl. Veterin.- og Landbohøjskoles Aarsskr. 32: 156. 1949.

TYPICAL HOST: *Carex prairea* Dewey.

SPECIMEN EXAMINED: H.H. Whetzel et al., May 16, 1918 [CUP 10544 (Holotype)].

155. *Sclerotinia luzulae* Whetzel, Farlowia 2: 434. 1946.

TYPICAL HOST: In culms of *Luzula pilosa* Willd.

NOTES: This epithet is based on an anamorph, *(Sclerotium)*.

156. *Sclerotinia mali* Takahashi, Bot. Mag. (Tokyo) 29: (222). 1915.
≡ *MONILINIA MALI* (Takahashi) Whetzel, Mycologia 37: 673. 1945.

TYPICAL HOST: On mummified young fruits of *Malus*.

157. *Sclerotinia malicola* Miura, Ringo no Byoki [Apple Diseases] p. 71, c.ic. 1917.

TYPICAL HOST: *Malus*.

NOTES: According to Dr. Yoshio Otani *(pers. comm.)*, this is probably a synonym of *Monilinia mali* (Takahashi) Whetzel. No type specimen is known.

158. *Sclerotinia matthiolae* Lendner, see *S. sclerotiorum*, No. 1 of this list.

159. *Sclerotinia megalospora* Woron., Mém. Acad. Imp. Sci. St. Pétersbourg VII, 36(6): 35. 1888.
≡ *MONILINIA MEGALOSPORA* (Woron.) Whetzel, Mycologia 37: 673. 1945.

TYPICAL HOST: Mummified fruits of *Vaccinium uliginosum* L.

160. *Sclerotinia menieri* Boud., Hist. classific. discomyc. Europe p. 108. 1907.

TYPICAL HOST: Leaves of *Phalaris arundinacea* L.

NOTES: Unfortunately Boudier's specimens are not available on loan at the present time. From the description alone, this is probably a *Myriosclerotinia*.

161. *Sclerotinia mespili* Woron. *in* Rehm *in* Rabenh., Krypt.-Fl. Deutschl. II, 1(3): 809. 1893.

TYPICAL HOST: Leaves of *Mespilus*.

NOTES: This epithet is based on an anamorph, *(Ovularia)*.

162. *Sclerotinia mespili* Schell., Centralbl. Bakteriol. 2 Abt., 17: 188, c.ic. - I,II. 1907 (later homonym).
≡ *MONILINIA MESPILI* Whetzel [ut "(Schell.) Whetzel"], Mycologia 37: 672. 1945.

TYPICAL HOST: Leaves of *Mespilus germanica* L.

NOTES: Though preoccupied in *Sclerotinia*, the epithet took on new life on transfer to *Monilinia* (International Code of Botanical Nomenclature, Art. 72.1 Note 1).

163. *Sclerotinia microspora* Velen., Monogr. discomyc. Bohem. 1: 226; 2: XXI(7). 1934. (!!)

TYPICAL HOST: On the nerves of the leaves of (?) *Rumex*.

SPECIMEN EXAMINED: J. Velenovský, 26.VI.1930 [PRM-Flora bohemica 152953 (Holotype)].

NOTES: The type specimen consists of detritus only. The diagnosis and illustration indicate that apothecia occur on the mid-vein of a leaf, possibly *Rumex*, and a discrete sclerotium is neither described nor illustrated. This is probably not a *Sclerotinia*, but may belong in *Lanzia*, *Poculum*, or *Lambertella*.

164. *Sclerotinia moelleriana* P. Henn., see *S. sclerotiorum*, No. 1 of this list.

165. [*Sclerotinia monieri* Sydow (ut "Boud."), Just's Bot. Jahresber. 35(1): 255. 1907, *lapsus calami* for *S. menieri*.]

166. *Sclerotinia moricola* Hino, Bull. Miyazaki Coll. Agric. 1(1): 77. 1930.
≡ *Botryotinia moricola* (Hino) Yamamoto, Trans. Mycol. Soc. Japan 2(2): 5. 1959.

TYPICAL HOST: *Morus alba*.

NOTES: This epithet is based on anamorphs.

167. *Sclerotinia mume* Hara, Agric. & Hort. 1: 24. 1926.
= *MONILINIA MUME* Yamamoto [ut "(Hara) Yamamoto"], Trans. Mycol. Soc. Japan 2(2): 3. 1959.

TYPICAL HOST: Fruits of *Prunus mume*.

NOTES: Yamamoto provided a description of the teleomorph. Hara's name is based on an anamorph.

168. *Sclerotinia muscorum* A.L. Smith & Ramsbottom, Trans. Brit. Mycol. Soc. 4: 168. 1913. (!!)

TYPICAL HOST: On leaves of *Campylopus atrovirens*.

SPECIMEN EXAMINED: Gwynne-Vaughan, April 1912 [K (Holotype)].

NOTES: No apothecia were found in the portion of the type specimen loaned. An ascocarp fitting the authors' description of an unexpanded, immature apothecium is referable to the Clavicipitales. The sclerotium, unconnected to any fruiting structure, is not that of a *Sclerotinia* sensu Kohn.

169. *Sclerotinia mycetophila* (Fayod) Sacc., Syll. fung. 10: 6. 1892.
≡ *Peziza mycetophila* Fayod, Ann. Sci. Nat., Bot., sér. 7, 2: 36, c.ic. - 2(13-18), 3(1-8). 1885.

TYPICAL HOST: *Agaricus vellereus* Fr.

NOTES: This fungus is described as producing an anamorph, *Monilia albo-lutea,* and therefore cannot be accommodated in *Sclerotinia.* While the Fayod herbarium is at G, including exsiccata, water color drawings, and notes, nothing under this epithet could be traced. The original description indicates that only one apothecium was observed, perhaps accounting for the absence of a type specimen.

170. *Sclerotinia myrtaceae* Rick (ut "*mystaceae*"), Egatea 13: 439. 1928. (!!)

TYPICAL HOST: Fruits of Myrtaceae.

SPECIMEN EXAMINED: Rick, Sept. 1905 [PACA-Rick 14841 (Holotype)].

NOTES: Much host tissue is incorporated in the sclerotial medulla and rind. This is probably a *Ciboria* but the apothecia are badly preserved and a conclusive determination is not possible.

171. [*Sclerotinia mystaceae* Rick, see *S. myrtaceae,* No. 170 of this list.]

172. [*Sclerotinia narcissi* Whitehouse, Biol. Rev. Cambridge Philos. Soc. 24: 432. 1949 (*nomen nudum*).]
= *STROMATINIA NARCISSI* Drayton & Groves, Mycologia 44: 126. 1952.

TYPICAL HOST: Bulb scales of *Narcissus* and *Zephyranthus.*

173. *Sclerotinia narcissicola* Gregory, Trans. Brit. Mycol. Soc. 25: 37. 1941.
≡ *BOTRYOTINIA NARCISSICOLA* (Gregory) Buchw., Kgl. Vet.- og Landbohøjskoles Aarsskr. 32: 148. 1949.

TYPICAL HOST: Leaves of *Narcissus pseudonarcissus.*

174. *Sclerotinia nervisequa* Schroet. *in* Cohn, Krypt.-Fl. Schlesien 3(2): 65. 1893.
≡ *Rutstroemia nervisequa* (Schroet. *in* Cohn) White, Lloydia 4: 223. 1941.

TYPICAL HOST: Midrib of leaf of *Alnus glutinosa.*

NOTES: The substratal stroma excludes this species from *Sclerotinia*

175. *Sclerotinia nervisequa* var. *bambusacea* Rehm, Leafl. Philipp. Bot. 8: 2930. 29.XII.1915.

TYPICAL HOST: Decayed leaves of *Bambusa vulgaris.*

NOTES: The substratal stroma excludes this taxon from *Sclerotinia.* The host on which it occurs is sufficiently different from that of *S. nervisequa* to suggest elevation to species rank, contingent upon type studies.

176. [*Sclerotinia nigricans* Whetzel (ut "Sacc."), Mycologia 36: 428. 1944, *pro synon., lapsus calami* for *Sclerotium nigricans* Sacc.]

177. [*Sclerotinia niponica* Lin, Cornell Univ. Thesis Abst. 1942: 341. 1942, *lapsus calami* for *Phaeosclerotinia nipponica* Hori *in* Sasaki; see No. 194 of this list.]

178. [*Sclerotinia nortoniana* Rehm (ut "Sacc."), Ber. Bayer. Bot. Ges. 15: 236. 1915, *lapsus calami* for *S. fructigena* Norton *ex* Sacc. & Sacc. *in* Sacc.]

179. *Sclerotinia nyssaegena* (Ellis) Rehm, Ann. Mycol. 4: 338. 1906.
≡ *Peziza nyssaegena* Ellis, Bull. Torrey Bot. Club 8: 73. VIII.1881.
≡ *CIBORIA NYSSAEGENA* (Ellis) Sacc. (ut "*nyssogena*"), Syll. fung. 8: 207. 1889.

TYPICAL HOST: On old drupes of *Nyssa multiflora*, buried under decaying leaves in muddy places.

180. *Sclerotinia ocymi* Vogl., Ann. R. Accad. Agric. Torino 52: 284. 1910.

TYPICAL HOST: *Ocymum basilicum.*

NOTES: On the basis of diagnosis only, which describes an anamorph determined by Voglino to be *Botrytis cinerea* f. *ocymi*, this species is probably a *Botryotinia.*

181. *Sclerotinia opuntiarum* Speg., see *S. sclerotiorum*, No. 1 of this list.

182. *Sclerotinia oreophila* Sacc., Atti Soc. Veneto-Trentina Sci. Nat. 4: 135. X.1875. (!!)

TYPICAL HOST: On leaves of *Vaccinium vitis-idaea.*

SPECIMEN EXAMINED: S. Venzo, 1873 [PAD-Saccardo 1822 (Holotype)].

NOTES: The stromatized bodies in the type specimen are not referable to *Sclerotinia;* they are poorly preserved and may be effete perithecia.

183. *Sclerotinia oxycocci* Woron., Mém. Acad. Imp. Sci. Saint Pétersbourg, sér. VII, 36: 28, c.ic. - VII. 1888.
≡ *MONILINIA OXYCOCCI* (Woron.) Honey, Amer. J. Botany 23: 105. 1936.

TYPICAL HOST: On decaying berries of *Vaccinium oxycoccus* L.

184. *Sclerotinia padi* Woron., Mém. Acad. Imp. Sci. St. Pétersbourg, sér. VIII, 2: 3, c.ic. - I-IV. 1895.
≡ *MONILINIA PADI* (Woron.) Honey, Amer. J. Bot. 23: 105. 1936.

TYPICAL HOST: Fruits of *Prunus padus.*

185. *Sclerotinia paeoniae* (Oud.) Massee, Textbook of pl. dis., p. 383. 1899.
≡ *BOTRYTIS PAEONIAE* Oud., Verslagen Meded. Kon. Akad. Wetensch., Amsterdam 5: 464. 1897. (n.v.)

TYPICAL HOST: On the stems of cultivated peonies.

NOTES: This epithet is based upon anamorphs. Massee made the transfer without having seen the teleomorph.

186. *Sclerotinia pallida* Velen., Monogr. discomyc. Bohem. 1: 224; 2: XXII(41). 1934. (!!)

TYPICAL HOST: Among grasses.

SPECIMEN EXAMINED: J. Velenovský, 11.VI.1931 [PRM-Flora bohemica 152951 (Holotype)].

NOTES: Svrček has annotated this specimen as *S. filipes* (Phill.) Sacc. (see No. 13 of this list under Taxa Imperfectly Known), the type specimen of which was not not available from K for comparison. The sclerotium, though not attached to host tissue, incorporates much host tissue within the medulla. Host data is vague ("among grasses") but tissue structure of the apothecium and sclerotium suggests that, barring the existence of a conidial anamorph, this may be a *Ciborinia*.

187. *Sclerotinia paludosa* Cash & Davidson *in* Davidson & Cash, Mycologia 25: 271. 1933.
≡ *Rutstroemia paludosa* (Cash & Davids. *in* Davids. & Cash) Groves & Elliott, Canad. J. Bot. 39: 225. 1961.

TYPICAL HOST: On overwintered leaves of *Carex exsiccata* Butler.

NOTES: As noted by Groves and Elliott *(loc. cit.)*, the sclerotia are those of a *Typhula*, and this species produces a substratal stroma.

188. *Sclerotinia panacis* Rankin, Phytopathology 2: 30. 23.II. 1912. (!!)
≡ *STROMATINIA PANACIS* (Rankin) Kohn, Phytopathology (in press). 1979.

TYPICAL HOST: "Black-rotted" tubers of cultivated ginseng, *Panax quinquefolium* L.

SPECIMEN EXAMINED: Whetzel, Reddick, Rankin, 5-7-[19]10 [CUP 5230 (Holotype)].

189. *Sclerotinia parasitica* (Cav.) Massee, Textbook of pl. dis. p. 383. 1899.
≡ *BOTRYTIS PARASITICA* Cav., Atti Ist. Bot. Univ. Pavia, ser. 2, 1: 432, c.ic. - VI(1-4). 1888.

TYPICAL HOST: On leaves, stems and flowers of cultivated tulips; sclerotia more especially on the bulbs.

NOTES: This epithet is based on anamorphs. Massee made the transfer without having seen a teleomorph, as pointed out by Hopkins (1921), who placed Cavara's species in synonymy with *Botrytis tulipae* (Lib.) Hopkins, an intra-anamorph "transfer" from *Sclerotium tulipae* Lib. Cavara's epithet appears to be the correct one to use in *Botrytis*.

190. [*Sclerotinia paridis* (Boud.) anon., Mycologia Index, Volumes 1-58, p. 424. 1968, *lapsus calami* for *Stromatinia paridis* Boud.]

191. [*Sclerotinia pelargonii* P. Sydow (ut "Scalia"), Just's Bot. Jahresb. 32(1): 235. 1905 ('1904'), *lapsus calami* for *Sclerotiopsis pelargonii* Scalia.]

192. *Sclerotinia pelargonii* (Rød) Rød *in* Jørstad, Nytt Mag. Bot. 6: 140. 1958.
≡ *BOTRYOTINIA PELARGONII* Rød, Blyttia 7: 77. 1949.

TYPICAL HOST: Leaves of *Pelargonium.*

NOTES: Rød no longer places *Botryotinia* at generic rank, but rather considers it a subgenus under *Sclerotinia.*

193. *Sclerotinia perplexa* Lawrence, Wash. Agric. Expt. Sta. Bull. 107: 10. 1912.
≡ *OVULINIA PERPLEXA* (Lawrence) Seaver, North Amer. cup-fungi (inoperc.) p. 65. 1951.

TYPICAL HOST: Roots and stems of *Helianthus tuberosus* L. and other species of *Helianthus, Brassica, Allium,* etc.

194. *Sclerotinia phaeospora* Hori, Engei no Tomo 8: 953. 1912.
≡ *Phaeosclerotinia nipponica* Hori *in* Sasaki (ut "*Phaeoscherotinia*"), Nippon Engei Zasshi 25: 38. 15.III. 1913; (ut "*Phaeosclerotinia*") Engei no Tomo 9: 351. 5.IV.1913, (a superfluous name change).
≡ *PHAEOSCLEROTINIA PHAEOSPORA* (Hori) Korf, Phytologia 21: 205. 1971.

TYPICAL HOST: Mummified fruits of *Pyrus malus.*

195. [*Sclerotinia phormi* P. Sydow (ut "d'Almeida & da Camara"), Just's Bot. Jahresb. 32(1): 235. 1905 ('1904'), *lapsus calami* for *Sclerotiopsis phormi* d'Almeida & da Camara.]

196. *Sclerotinia ploettneriana* Kirschst. *in* Rehm (ut "*plöttneriana*"), Ascom. Exs. *1603*. 1905; Verh. Bot. Vereins Brandenburg 48: 43. 1906.
≡ *CIBORIA PLOETTNERIANA* (Kirschst. *in* Rehm) Buchw., (ut "*plöttneriana*"), Kgl. Vet.- og Landbohøjskoles Aarsskr. 32: 165. 1949.

TYPICAL HOST: Stromatized seeds of *Veronica hederifolia.*

197. [*Sclerotinia podophyllina* (Whetzel *ex* Groves & Elliott) von Arx, Genera of fungi sporul. pure cult. p. 78. 1970 (not validly published: basionym not cited, Art. 33.2).]
≡ [*Septotinia podophyllina* Whetzel, Mycologia 29: 128. 1937 (not validly published: no Latin diagnosis, Art. 36.1).]
≡ *SEPTOTINIA PODOPHYLLINA* Whetzel *ex* Groves & Elliott, Can. J. Bot. 39: 227. 1961.

TYPICAL HOST: On *Podophyllum peltatum.*

198. *Sclerotinia polyblastis* Gregory, Trans. Brit. Mycol. Soc. 22: 202. 1938.
≡ *BOTRYOTINIA POLYBLASTIS* (Gregory) Buchw., Kgl. Vet.- og Landbohøjskoles Aarsskr. 32: 148. 1949.

TYPICAL HOST: Overwintered leaves of *Narcissus tazetta* 'Soleil d'Or.'

199. *Sclerotinia polycodii* Reade, Ann. Mycol. 6: 110. 1908.
≡ [*Monilinia polycodii* Honey, Amer. J. Bot. 23: 101. 1936 *(nomen nudum)*.]
≡ *MONILINIA POLYCODII* (Reade) Honey *in* Whetzel, Mycologia 37: 673. 1945.

TYPICAL HOST: On twigs and fruits of *Polycodium stramineum* (L.) Greene, in moist woods.

NOTES: This is based on the teleomorph; an anamorph, *Monilia polycodii* Reade, is also formed.

200. *Sclerotinia polygoni* Rehm, Ber. Bayer. Bot. Ges. 15: 238. 1915.
≡ *CIBORIA POLYGONI* (Rehm) Buchw., Kgl. Vet.- og Landbohøjskoles Aarsskr. 32: 165. 1949.

TYPICAL HOST: On fallen fruits of *Polygonum aviculare*.

201. *Sclerotinia porri* van Beyma, Meded. Phytopathol. Lab. "Willie Commelin Scholten" 10: 46. II.1927.
≡ *BOTRYOTINIA PORRI* (van Beyma) Whetzel, Mycologia 37: 680. 1945.

TYPICAL HOST: Seeds of *Allium porri*.

202. *Sclerotinia postuma* Berk. & Wilson, see *S. sclerotiorum*, No. 1 of this list.

203. *Sclerotinia pruni* Speg. & Roum., see *S. spinosae*, No. 231 of this list.

204. *Sclerotinia pruni-spinosae* (Lib.) Speg. & Roum., see *S. spinosae*, No. 231 of this list.

205. *Sclerotinia pseudotuberosa* (Rehm *ex* Rehm) Rehm *in* Rabenh., Krypt.-Fl. Deutschl. II 1(3): 809. 1893.
≡ [*Ciboria pseudotuberosa* Rehm, Ascom. Exsicc. *106*. 1872 (1873?) *(nomen nudum)*.]
≡ [*Peziza pseudotuberosa* (Rehm) Cooke, Grevillea 4: 132, c.ic. - 65(288). 1876 *(nomen nudum ?)*.]
≡ *Ciboria pseudotuberosa* Rehm *ex* Rehm, Ber. Naturhist. Vereins Augsburg 26: 28. 1881.

TYPICAL HOST: Fallen, rotting fruits of *Quercus*.

NOTES: The highly involved synonymy is discussed at length by Buchwald (1954). If it is held that Cooke's *(loc. cit.)* sketch of an ascus, ascospores and paraphysis qualify under Art. 44.1 of the International Code of Botanical Nomenclature as "an illustration with analysis showing essential characters," Rehm's name would date from 1876. In that event, the correct name for the fungus would be *Ciboria pseudotuberosa* (Rehm *ex* Cooke) Rehm 1881. I prefer to treat it as a nomen nudum until 1881, in which event *Ciboria batschiana* (Zopf *in* Zopf & Sydow) Buchw. becomes the correct name (see No. 49 of this list).

206. [*Sclerotinia pustula* Oudemans γ *castaneae* Oudemans (ut "*pustula* DC. γ *castaneae* DC."), Enum. syst. fung. 2:

662. 1920, *lapsus calami* for *Sclerotium pustula* DC. γ *castaneae* DC.]

207. [*Sclerotinia ranunculi* Whetzel *in* Buchw., Kgl. Vet.- og Landbohøjskoles Aarsskr. 32: 134. 1949 *(nomen nudum)*.]
= *BOTRYOTINIA RANUNCULI* Hennebert & Groves, Canad. J. Bot. 41: 348. 1963.

TYPICAL HOST: *Ranunculus septentrionalis* Poir.

208. *Sclerotinia rapulum* (Bull. *ex* Mérat) Rehm (ut "*rapula*") *in* Rabenh., Krypt.-Fl. Deutschl. II 1(3): 823. 1893.
≡ [*Peziza rapulum* Bull., Champ. franç. p. 265, c.ic. - 485 (3). 1791.]
≡ *Peziza rapulum* (Bull.) *ex* Mérat, Nouv. fl. envir. Paris, ed. 2, 1: 24. 1821.
≡ *STROMATINIA RAPULUM* (Bull. *ex* Mérat) Boud., Hist. classific. discom. Europe p. 108. 1907.

TYPICAL HOST: In rich soil.

209. *Sclerotinia rathenowiana* Kirschst., Verh. Bot. Vereins Prov. Brandenburg 48: 43. 1906; Rehm, Ascom. Exsicc. *1649*. 1906. (!!)

TYPICAL HOST: Stromatized branchlets, twigs and petioles of *Salix* spp.

SPECIMEN EXAMINED: Kirschstein, 5/1905 [S-Rehm, Ascom. Exsicc. *1649* (Isotype)].

NOTES: The published exsiccata list (Ann. Mycol. 4: 70. 1906) mentions the production of a *Botrytis* anamorph. This is probably a *Botryotinia* or, barring the production of a conidial anamorph, a *Ciborinia*.

210. *Sclerotinia rehmiana* Rick, Oesterr. Bot. Z. 48: 342. VIII. 1898. (!)

TYPICAL HOST: Dead stems of *Impatiens noli-tangere*.

SPECIMEN EXAMINED: Rick, 5/98 [S-Rehm (Authentic)].

NOTES: This is probably a *Ciborinia*. Although free from the host, the sclerotium incorporates much host tissue within the medulla.

211. *Sclerotinia rhododendri* Fischer, [Mitt. Naturf. Ges. Bern 1265-1278: XVII. 1892, *(nomen provis.)*]; Ber. Schweiz. Bot. Ges. 4: 1. 1894.
≡ *MONILINIA RHODODENDRI* (Fischer) Whetzel, Mycologia 37: 673. 1945.

TYPICAL HOST: Conidial anamorph on *Vaccinium;* apothecial teleomorph produced on fruits of *Rhododendron*.

212. *Sclerotinia richteriana* P. Henn. & Staritz, Hedwigia 42: (18). 1903. (!)

TYPICAL HOST: On rhizomes of *Polygonatum multiflorum*.

SPECIMEN EXAMINED: Staritz, 4.1908 [CUP-Durand 102-88 ex Staritz (Authentic)].

NOTES: This is a later synonym of *Stromatinia rapulum* (Bull. *ex* Mérat) Boud.

213. *Sclerotinia ricini* Godfrey, Phytopathology 9: 565. 1919.
   ≡ *BOTRYOTINIA RICINI* (Godfrey) Whetzel, Mycologia 37: 680. 1945.

TYPICAL HOST: Inflorescences, stems and leaves of *Ricinus communis*.

NOTES: The conidial anamorph is sufficiently unlike a typical *Botrytis* that Hennebert (1973) erected a new genus for it, where it becomes *Amphobotrys ricini* (Buchw.) Hennebert.

214. *Sclerotinia riograndensis* Rick, see *S. sclerotiorum*, No. 1 of this list.

215. [*Sclerotinia rolfsii* Burnett, Fundam. mycol., ed. 2, pp. 126, 606. 1976, *lapsus calami* for *Sclerotium rolfsii* Sacc.]

216. *Sclerotinia salicina* Velen., Monogr. discomyc. Bohem. 1: 226. 1934.

TYPICAL HOST: On branchlets of *Salix*.

NOTES: The type specimen was not included with the loan of Velenovský specimens from PRM and having received no reply to my inquiry I assume that it is unavailable or nonexistent. On the basis of diagnosis alone, this species, occurring on the branchlets of *Salix*, is not a *Sclerotinia* and should be compared with *S. rathenowiana*, No. 209 of this list.

217. *Sclerotinia sativa* Drayton & Groves, see *S. minor*, No. 2 of this list.

218. *Sclerotinia schoenicola* Whetzel, Farlowia 2: 425. 1946.

TYPICAL HOST: Culms of *Schoenus nigricans* L.

NOTES: This epithet is based on an anamorph *(Sclerotium)*.

219. *Sclerotinia scirpicola* Rehm *in* Rabenh., Krypt. Fl. Deutschl. II 1(3): 822. 1893.
   ≡ *MYRIOSCLEROTINIA SCIRPICOLA* (Rehm *in* Rabenh.) Buchw., Friesia 3: 296. 1947.

TYPICAL HOST: Rottings stalks of *Scirpus lacustris*.

220. *Sclerotinia sclerotiorum* var. *opuntiarum* (Speg.) Alippi, see *S. sclerotiorum*, No. 1 of this list.

221. *Sclerotinia sclerotiorum* forma *orobanches* Narasimhan & Thirumalachar, see *S. sclerotiorum*, No. 1 of this list.

222. *Sclerotinia seaveri* Rehm, Ann. Mycol. 3: 519. 1905.
   ≡ *MONILINIA SEAVERI* (Rehm) Honey, Amer. J. Bot. 23: 105. 1936.

TYPICAL HOST: On stones of drupes of *Prunus serotinus*.

223. *Sclerotinia secalincola* Rehm, Hedwigia 39: (192). 1900.

TYPICAL HOST: On rotting caryopses of *Secale cerealis.*

NOTES: This is a taxonomic synonym of *Gloeotinia granigena* (Quél.) Schum., No. 123 of this list, as noted by Schumacher (1979). Buchwald (1947) also noted it as a synonym of *Ciboria temulenta* (Prill. & Delacr.) Prill. & Delacr., No. 238 of this list, which in turn is a synonym of *G. granigena.*

224. *Sclerotinia seminis* (Cooke & Phill.) Rehm *in* Rabenh., Krypt.-Fl. Deutschl. II 1(3): 818. 1893.
≡ *Peziza seminis* Cooke & Phill., Grevillea 10: 104. III. 1881. (!!)

TYPICAL HOST: Growing on *Sclerotium semen* Tode *ex* Mérat.

SPECIMEN EXAMINED: On *Sclerotium semen,* autumn [K-Reliq. Libertianae 894 (Holotype)].

NOTES: This is not referable to the Sclerotiniaceae. There is no evidence that the apothecia are genetically related to the sclerotia on which they have developed. The anatomy of the sclerotium is reminiscent of that of a *Typhula.*

225. *Sclerotinia serica* Keay, J. Bot. 75: 132. 1937. (!!) (!)
≡ *STROMATINIA SERICA* (Keay) Kohn, Phytopathology (in press). 1979.

TYPICAL HOST: Parasitic on *Gypsophila elegans.*

SPECIMENS EXAMINED: Keay, Aug. 4, 1938 [CUP 28053 (Authentic)]; Keay, "dried 23.4.1935" [K (Holotype)].

226. *Sclerotinia shiraiana* P. Henn. *in* Engler, Bot. Jahrb. Syst. 28: 278. 1900.
≡ *Scleromitrula shiraiana* (P. Henn. *in* Engler) Imai, J. Fac. Agr. Hokkaido Imp. Univ. 45: 177, c.ic. - VI(17). 1941.
≡ *Ciboria shiraiana* (P. Henn. *in* Engler) Whetzel, Mycologia 37: 489. 1945.

TYPICAL HOST: On fruits of *Morus alba.*

NOTES: It is possible that *Scleromitrula* may provide the acceptable generic name for this species. Korf (1973) accepted that genus. There is an apparently unnamed anamorph with dry conidia.

227. *Sclerotinia smilacinae* Durand, Bull. Torrey Bot. Club 29: 462. 1902.
≡ *Stromatinia smilacinae* (Durand) Whetzel, Mycologia 37: 674. 1945.

TYPICAL HOST: Dead rhizomes of *Smilacina racemosa* buried in rich humus [but, according to Korf & Gruff (1978), the host was misidentified, and is instead *Polygonatum*].

NOTES: According to Korf & Gruff (1978) this is a taxonomic synonym of *Stromatinia rapulum,* No. 208 of this list.

228. *Sclerotinia solani* Vañha, Wiener landwirtschaftlichen Zeitung 60: 966. 1910.

TYPICAL HOST: *Solanum tuberosum* L.

NOTES: This epithet is based upon anamorphs.

229. *Sclerotinia spermophila* Noble, Trans. Brit. Mycol. Soc. 30: 90. 1948.

TYPICAL HOST: Seeds of *Trifolium repens* L.

NOTES: According to G.L. Hennebert *(pers. comm.)* this epithet is referable to *Botryotinia* or to an unnamed new genus.

230. *Sclerotinia sphaerosperma* Gregory, Trans. Brit. Mycol. Soc. 25: 37. 1941.
≡ *BOTRYOTINIA SPHAEROSPERMA* (Gregory) Buchw., Kgl. Vet.- og Landbohøjskoles Aarsskr. 32: 148. 1949.

TYPICAL HOST: On leaves of *Allium triquetrum.*

231. *Sclerotinia spinosae* (Lib. *in* Cooke) Velen., Monogr. discomyc. Bohem. 1: 226. 1934.
≡ *Peziza spinosae* Lib. *in* Cooke, Grevillea 8: 84. III.1880.
≡ *Sclerotinia pruni-spinosae* Speg. & Roum. [ut "(Lib.) Speg. & Roum."], Fungi sel. gall. exsicc. *642.* 1880 (a superfluous name change).
≡ [*Sclerotinia pruni* Speg. & Roum. *ex* Thuemen, Mycoth. univ. *1613.* 1880 *(lapsus calami* for *S. pruni-spinosae).*]
≡ *Rutstroemia pruni-spinosae* (Speg. & Roum.) Whetzel & White *in* White [ut "(Lib.) Whetzel & White"], Lloydia 4: 219. 1941.

TYPICAL HOST: On fallen leaves of *Prunus spinosa.*

NOTES: Though Libert's herbarium labels had the epithet as "pruni-spinosae," Cooke intentionally changed it to *Peziza spinosae* at the time of publication; many later authors have seen fit to restore the original epithet. The substratal stroma clearly excludes this species from *Sclerotinia.*

232. *Sclerotinia spinosae* var. *minor* Velen., Novit. mycol. noviss. p. 129. 1947.

TYPICAL HOST: On leaves of *Ligustrum.*

NOTES: Based on the extremely brief description and on Velenovský's concept of the species, this is not referable to *Sclerotinia.*

233. [*Sclerotinia spinosae* var. *pallida* Velen., Monogr. discomyc. Bohem. 2: pl. XXVII(22). 1934 *(nomen nudum)*.]

NOTES: By a circuitous connection a description may exist on p. 208 of Velenovský's Novitates mycologicae 1939, where some brief descriptive comments are made regarding an unnamed variety of this species ommitted by error from his Monographia discomycetum bohemicae on p. 226. On that page is a reference to the figure cited above, the legend of which uses the name "var. *pallida.*" Since the description is minimal, and the connection to the epithet "pallida" tenuous, I treat this as a *nomen nudum.*

234. *Sclerotinia squamosa* (Viennot-Bourgin) Dennis, Mycol. Pap. 62: 157. 1956.
  ≡ *BOTRYOTINIA SQUAMOSA* Viennot-Bourgin, Ann. Épiphyt. sér. C, 4: 38. 1953.

TYPICAL HOST: On leaves of *Allium cepa.*

235. *Sclerotinia subularis* (Bull. *ex* Mérat) Rehm *in* Rabenh., Krypt.-Fl. Deutschl. II 1(3): 818. 1893.
  ≡ [*Peziza subularis* Bull., Champ. franç., p. 235, c.ic. - 500(2). 1791 (pre-starting point).]
  ≡ *Peziza subularis* Bull. *ex* Mérat, Nouv. fl. envir. Paris, ed. 2, 1: 23. 1821.
  ≡ *Ciboria subularis* (Bull. *ex* Mérat) Sacc., Syll. fung. 8: 203. 1889.

TYPICAL HOST: Fallen fruits of *Helianthus annuus.*

NOTES: From the diagnosis alone, this species may be referable to *Ciboria, Lanzia,* or *Poculum.*

236. *Sclerotinia sulcata* (Roberge *in* Desm.) Whetzel [ut "(Desm.)"], Mycologia 37: 666. 1945; Farlowia 2: 397. 1946.
  ≡ *SCLEROTIUM SULCATUM* Roberge *in* Desm., Ann. Sci. Nat., sér. 3, 16: 329. 1851.
  ≡ [*Sclerotinia sulcata* (Roberge *in* Desm.) Whetzel [ut "(Desm.)"], Mycologia 21: 15. 1929 *(nomen provis.).*]
  ≡ [*Myriosclerotinia sulcata* (Whetzel) Buchw. [ut "non ... (Desm.) Whetz."], Friesia 3: 301. 1947.]

TYPICAL HOST: In culms of *Carex stricta* Lam.

NOTES: In 1929 Whetzel only provisionally transferred the epithet "sulcata" to *Sclerotinia.* In 1945 he adopted the name, a transfer of the original anamorphic *Sclerotium sulcatum.* Even though Whetzel described the teleomorph in 1946, no Latin diagnosis was provided there; the name in *Sclerotinia* is preoccupied by the anamorph. Buchwald then attempted to transfer the teleomorph, which he credited to Whetzel, but the combination in *Myriosclerotinia* is also not validly published since the basionym is not validly published. The teleomorph lacks a valid name.

237. [*Sclerotinia taxa* anon., Mycologia Index, volumes 1-58, p. 425. 1968, *lapsus calami* for *S. laxa.*]

238. *Sclerotinia temulenta* (Prill. & Delacr.) Rehm *in* Höhn., Ann. Mycol. 1: 406. 1903.
  ≡ *Phialea temulenta* Prill. & Delacr., Bull. Soc. Mycol. France 8: 23. 1892.
  ≡ *Peziza (Phialea) temulenta* (Prill. & Delacr.) Prill. (ut "Prill. & Delacr."), Bull. Soc. Bot. France 39: 169. 1.IX.1892.
  ≡ *Gloeotinia temulenta* (Prill. & Delacr.) Wilson, Noble & Gray, Trans. Brit. Mycol. Soc. 37: 31. 1954.

TYPICAL HOST: On fruits of *Secale cereale* L.

NOTES: Schumacher (1979) finds *Gloeotinia granigena*, No. 123 of this list, to be the correct name.

239. *Sclerotinia tenella* (Karst.) Boud., Hist. classific. discomyc. Europe p. 107. 1907.
   ≡ *Ciboria ciborioides* (Fr. *ex* Fr.) Karst. forma *tenella* Karst. (ut "*Rutstroemia ciborioides* f. *tenella*"), Hedwigia 26: 124. 1887.
   ≡ [*Rutstroemia ciborioides* (Fr. *ex* Fr.) Karst. forma *tenella* Karst., Hedwigia 26: 124. 1887 *(lapsus calami)*.]
   ≡ *Ciboria tenella* (Karst.) Sacc., Syll. fung. 8: 208. 1889.
   ≡ [*Ciboria friesii* subsp. *tenella* (Karst.) Sacc., Syll. fung. 8: 208. 1889, *pro synon.*]

TYPICAL HOST: Rotting culms of *Carex*.

NOTES: This appears to have a substratal stroma and thus cannot be a *Sclerotinia*. For comments on Karsten's inadvertant error in placing this forma under *Rutstroemia*, see notes under *S. ciborioides*, No. 68 of this list.

240. *Sclerotinia tenuispora* Velen., Monogr. discomyc. bohem. 1: 226; 2: XXI(26). 1934. (!!)

TYPICAL HOST: In marshy meadow.

SPECIMEN EXAMINED: J. Velenovský, 3.VIII.1929 [PRM-Flora bohemica 152958 (Holotype)].

NOTES: This is certainly a *Ciborinia*. The sclerotium has enveloped an entire vascular bundle of a herbaceous stem (unidentified) and the apothecial microanatomy agrees with that of *Ciborinia*, with an ectal excipulum of globose cells.

241. *Sclerotinia tiliae* Reade, Ann. Mycol. 6: 114. 1908.
   ≡ *CIBORIA TILIAE* (Reade) Buchw., Kgl. Vet.- og Landbohøjskoles Aarsskr. 32: 165. 1949.

TYPICAL HOST: Sclerotia in seeds of *Tilia americana* L. lying on the ground.

242. *Sclerotinia trifolii* Biffen, see *S. trifoliorum*, No. 3 of this list.

243. [*Sclerotinia trifoliorum* var. *minor* Alcock, Trans. Bot. Soc. Edinburgh 30: 334. 1931 *(nomen nudum)*.]

244. *Sclerotinia tuberosa* Fuckel [ut "(Hedw.)"], Jahrb. Nassauischen Vereins Naturk. 23-24: 331. 1870 (a new name [ICBN, Art. 72.1 Note 1]).
   ≡ [*Octospora tuberosa* Hedw., Musci frond. 2: 33, c.ic. - X(B). 1789 (pre-starting point: not validly published [ICBN, Art. 13.1(f)]).]
   ≡ [*Peziza tuberosa* (Hedw.) Dickson, Fasc. pl. crypt. brit. 2: 25. 1790 (pre-starting point: not validly published [ICBN, Art. 13.1(f)]).]
   ≡ *Peziza tuberosa* (Hedw.) Dickson *ex* Ficinus & Schubert (ut "Diks."), Flora Dresden Ed. 2, 2: 456. 1823 (validly published later homonym: illegitimate), not *P. tuberosa* Bull. *ex* Mérat 1821.

≡ *Phialea tuberosa* Gillet (ut "Hedw."), Champ. France discomyc. p. 97. 1881 (1882?) (a name name [ICBN, Art. 72.1 Note 1]).

= [*Peziza tuberosa* Bull., Hist. champ. France p. 266, c.ic. 485(2-3). 1791 (pre-starting point: not validly published [ICBN, Art. 13.1(f)]).]

≡ *Peziza tuberosa* Bull. *ex* Mérat, Nouv. fl. envir. Paris Ed. 2, 1: 24. 1821 (*sanctioned* [ICBN, Art. 13.1(f)] by Fries, Syst. mycol. 2(1): 58. 1822, 2(2): 612. 1823).

≡ *Macroscyphus tuberosus* (Bull. *ex* Mérat) S.F. Gray (ut "Dickson, Sowerby, Persoon"), Nat. arr. Brit. pl. 1: 672. 1821.

≡ *Rutstroemia tuberosa* (Bull. *ex* Mérat) Karst., Bidrag Kännedom Finlands Natur Folk 19: 105. 1871.

≡ *Hymenoscyphus tuberosus* (Bull. *ex* Mérat) Phill. (ut "*Hymenoscypha tuberosa*"), Man. Brit. discomyc. p. 113. 1887.

≡ *Whetzelinia tuberosa* (Bull. *ex* Mérat) Korf & Dumont [ut "(Hedw. *ex* Mérat)"], Mycologia 64: 250. 1972.

≡ *DUMONTINIA TUBEROSA* (Bull. *ex* Mérat) Kohn, Mycotaxon 9: 432. 1979.

?= *Peziza tuberosa* α *nigra* Grognot, Pl. crypt. Saône-et-Loire p. 206. 1863.

= *Sclerotinia infundibuliformis* Peck, Bull. Torrey Bot. Club 23: 420. X.1896. (!)

?= *Sclerotinia tuberosa* forma *pallida* P. Henn., Verh. Bot. Vereins Prov. Brandenburg 40: XXVII. 1899.

= *Sclerotinia ulmariae* Velen., Monogr. discomyc. Bohem. 1: 223. 1934. (!!)

TYPICAL HOST OF BASIONYM: Deeply immersed in soil.

TYPICAL HOSTS OF SYNONYMS: Dead roots of *Anemone nemorosa (Octospora tuberosa);* in the woods *(Peziza tuberosa* α *nigra);* wet woods *(Sclerotinia infundibuliformis); Anemone nemorosa* L. and *A. ranunculoides* L. *(S. tuberosa* f. *pallida);* rhizomes of *Spiraea ulmaria (Sclerotinia ulmariae).*

EXSICCATI SPECIMENS EXAMINED: (All were issued under the generic name *Sclerotinia* except as indicated.) *Austria:* Rick, (date not indicated), ad terram, Voralberg, Feldkirch [FH: RABENHORST-PAZSCHKE, FUNGI EUROPAEI ET EXTRAEUROPAEI *4472*].

Belgium: Dumont, (date not indicated0, sur la terre, dans les bois humides et ombragés des environs de Mons [NY: WESTENDORP & WALLAYS, HERBIER CRYPTOGAMIC *990 (Peziza)*].

Czechoslovakia: L. Kavina & D.K. Kavina, IV.1935, in rhizomatibus *Anemone nemorosae*, in pratis montis Zvičina, Bohemia orientalis [NY: LAVINA & HILITZER, CRYPTOGAMAE ČECHOSLOVENICAE *221*]; (collector not indicated), vere 1856, in pratis subhumidis sylvaticis, Schluckenau [NY: RABENHORST, HERB. MYCOLOGICUM, ED. II *308 (Peziza)*].

England: (no collection data) [BPI: BERKELEY, BRITISH FUNGI *153 (Peziza)*]; Plowright, (date and substrate not indicated), King's Lynn [NY: COOKE, FUNGI BRITANNICI *558 (Peziza)*]; Plowright, (date, substrate and locality not indicated) [CUP-Durand: PHILLIPS, ELVELLACEI BRITANNICI *7 (Peziza)*]; Phillips, (date and substrate not indicated), Shrewsbury [NY: VIZE, MICRO-FUNGI BRITANNICI *358 (Peziza)*].

France: (collector and date not indicated), profondément implanté en terre, dans les bois humides, dans les pâturages monteux des Vosges [NY: DESMAZIÈRES, PLANTES CRYPTOGAMES DE FRANCE *1739 (Peziza)*]; (collector not indicated) Aprili, in pascuis montosis (locality not indicated) [NY; CUP-Durand, MOUGEOT & NESTLER, STIRPES CRYPTOGAMAE VOGESO-RHENANAE *397 (Peziza)*]; (collector not indicated), Aprili, In pascuis montosis, (locality not indicated) [CUP-Durand: ROUMEGUÈRE, FUNGI SELECTI GALLIAEI *161 (Peziza)*]; Sarrazin, 23 mars 1884, (substrate not indicated), Forêt de Hallate (Oise), Canton de Rigolet, près la route de Creil [CUP-Durand: ROUMEGUÈRE, FUNGI SELECTI GALLIAEI *2945 (Rutstroemia)*]; Sarrazin, mars 1885, au voisinage de l'*Anemone ranunculoides*, les boid des environs de Senlis (Seine-et-Oise) [CUP-Durand: ROUMEGUÈRE, FUNGI SELECTI GALLIAEI *3337 (Peziza)*].

Germany: Krieger, 29. April, 2. Mai 1896, auf abgestorbenen Rhizomen von *Anemone nemorosa* L., in einem Thale zwischen Waltersdorf und Prossen, Sächs. Schweiz [NY: KRIEGER, FUNGI SAXONICI *1175*]; Thomas, 20. April 1901, auf *Anemone nemorosa* L., Garten der Herrn Prof. Thomas in Ohrdruf in Thüringen [FH: KRIEGER, SCHÄDLICHE PILZE UNSERER KULTURGEWÄCHSE *134*]; Zimmermann, 4.1910, auf *Anemone ranunculoides*, Eisgrub in Mähren:Park [FH: PETRAK, FLORA BOHEMIAE ET MORAVIAE *282*]; Hruby, 4.1913, auf *Anemone nemorosa*, Weidenau in Öst-Schlesien [FH: PETRAK, FLORA BOHEMIAE ET MORAVIAE *282b*]; Ludwig, VI.1924, *Anemone nemorosa*, Westfalen; Kr. Siegen: Burgholdinghausen [FH: PETRAK, MYCOTHECA GENERALIS *145*]; Magnus, 12/4.1874, unter *Anemone nemorosa*, Berlin [FH: REHM, ASCOMYCETEN *202*]; Staritz, 5/1883, (substrate not indicated), Schlossgarten von Tulsnitz in Sachsen [FH: CUP-Durand: REHM, ASCOMYCETEN *202b*]; Britzelmayr, 6/1905, Wiese bei Ritzmais, bayerischen Wald [CUP-Durand: REHM, ASCOMYCETEN *202c*]; Rupprecht, 18.4.1922, auf Rhizomen von *Anemone tuberosa*, Westfalen: am Spechtsbach in Kölnischen Wald bei Bottrop [FH: SYDOW, MYCOTHECA GERMANICA *1940*]; Henkel, 6.4.1923, Auf Rhizomen von *Anemone nemorosa*, Thüringen: bei Pfiffelbach [FH: SYDOW, MYCOTHECA GERMANICA *2167*]; Sydow, Mai 1879, auf *Anemone nemorosa*, Charlottenburger Schlofsgarten [FH: CUP-Durand: ZOPF & SYDOW, MYCOTHECA MARCHICA *76*].

Italy: Pollacci, (date not indicated), ad terram, Horto botanico ticinensi [FH: POLLACCI, FUNGI LONGOBARDIAE EXSICCATI *316* (issued as *Sclerotinia libertiana*)]; Saccardo, May 1880, in umbrosis Horti botanici, Padova [NY: SACCARDO, MYCOTHECA VENETA *1517*]; Saccardo, March 1901, in horto botanico - ad terram umbrosam, Padova [NY: SACCARDO, MYCOTHECA ITALICA *667*].

Poland: Fedorowicz, 6.IV.1919, (substrate and locality in Polish) [FH: RACIBORSKI, MYCOTHECA POLONICA *84*].

Sweden: Lundell, 4.V.1933, Sclerotia in the rhizomes of *Anemone nemorosa*, Upland: Danmark parish, Pustnäs (near Upsala) [BPI: LUNDELL & NANNFELDT, FUNGI EXSICCATI SUECICI *90*]; Hylander, 11.V.1945, Sclerotia in the rhizomes of cultivated *Anemone nemorosa* × *ranunculoides*, Upland: Upsala, Botanic Garden [BPI: LUNDELL & NANNFELDT, FUNGI EXSICCATI SUECICI *2400*].

Soviet Union: Raitviir, IV.1959, Ad rhizomata *Anemones nemorosae* in piceeto caeso, Distr. Tartu, Vasula [FH: BPI: PARMASTO, MYCOTHECA ESTONICA *55*].

OTHER SPECIMENS EXAMINED: *Canada:* Malloch, 7.V.1978, in soil under *Crataegus* sp., Mississauga, Ontario, CUP 58245; Elliott, 6.V.1975, isolated from apothecium on sclerotium under *Sanguinaria canadensis*, Carleton Co., Ontario, CUP 59808 (no apothecia) = DAOM 150668; Waghorne, 13.VI.1896, Newfoundland [CUP-Durand 102-57, AUTHENTIC material of *Sclerotinia infundibuliformis*].

Czechoslovakia: Velenovský, IV.1934, infra klohočna ad rhiz. *Ulmariae* [PRM-Flora bohemica 152949, HOLOTYPE of *Sclerotinia ulmariae*].

Germany: Matheis *634*, 10.IV.1976, on *Anemone nemorosa*, Würzburg, CUP 54734; Matheis *633*, 10.IV.1976, on *Anemone nemorosa*, Würzburg, CUP 54733;

Matheis *635*, 10.IV.1976, on *Anemone nemorosa*, Würzburg, CUP 54735.

Switzerland: Matheis & Korf families, 15.IV.1973, Güttingen, on *Anemone nemorosa*, CUP 52881 [isolate from ascospores from this collection deposited as CUP 58253 = Hennebert 19091 = MUCL 19091].

UNITED STATES: Iowa: Martin, April 26, 1927, soil, Iowa City, CUP 15586.

New York: Korf, Noviello & Hennebert, 15.V.1961, (substrate not indicated), Danby, CUP 45392; Seaver, Apr. 20, 1915, New York City, [NY-Seaver]; Whetzel & Miss Rice, 5/1/38, *Asarum canadense*, McLean, CUP 27320.

North Dakota: Barnett, May 12, 1932, ground among fallen leaves, woods N. Fargo, [NY].

Virginia: Artschwager, 4/6/28, soil among early spring flowers, *Erythronium, Decutaria*, etc., Black Pond, Fairfax Co., along Potomac River, CUP 16314.

Wisconsin: Honey, 5/21/44, (substrate not indicated), Antigo Tp., Langeade Co., CUP 33941.

NOTES: An examination of the above synonymy reveals several problems engended by the later starting point provisions of the ICBN. A discussion of these will be presented in a separate paper (Korf and Kohn, *in prep.*). The ectal excipulum of the apothecium is composed of textura porrecta, with no globose cells, excluding this species from my emended circumscription of *Sclerotinia*. Also, the rind of the sclerotium is composed of clavate cells with the outermost wall of the outer layer of cells very heavily melanized. These characters, in addition to the lack of a conidial state and a true tuberoid sclerotium developing free from host tissue, preclude assignment to any known genus in the Sclerotiniaceae. I therefore erect the following new genus to accommodate this species.

DUMONTINIA Kohn, *gen. nov.*

Sclerotia tuberoidea, substantiam hospitis non includentia. Cortex sclerotialis texturae prismaticae strato exteriore cellularum clavatarum praeditus, harum muris extimis valde denigratis, crustam formantibus. Apothecia stipitata, cupulata, sclerotiis portata. Excipulum ectale ex textura porrecta intertexta et plerumque in strato gelatinoso contenta formatum. A *Sclerotinia* et *Ciborinia* differens in absentia cellularum globosarum ab excipulo ectali apothecii et a generibus Sclerotiniacearum alliis in absentia status conidialis et in formatione sclerotiorum verorum. A *Elliottinia* differens in absentia substantiae hospitis in medulla sclerotiali. Species typica: *Peziza tuberosa* Bull. *ex* Mérat.

Sclerotia tuberoid, not incorporating host tissues; sclerotial rind of textura prismatica with outer layer of cells clavate, outermost walls of these cells heavily melanized, forming a dense crust. *Apothecia* stipitate, cupulate, borne on sclerotia. Ectal excipulum of textuta porrecta, interwoven and usually bound in a layer of gel. Differing from *Sclerotinia* and *Ciborinia* in the absence of globose cells in the ectal excipulum of the apothecium and from other genera in the Sclerotiniaceae in the absence of a conidial state and the formation of true sclerotia. Differing from *Elliottinia* in the absence of host tissue within the sclerotial medulla. Holotype species: DUMONTINIA TUBEROSA (Bull. *ex* Mérat) Kohn, *comb. nov.* (basionym: *Peziza tuberosa* Bull. *ex* Mérat, Nouv. fl. envir. Paris, Ed. 2, 1: 24. 1821).

Etymology: Named for Kent P. Dumont, colleage in studies in the Sclerotiniaceae.

DUMONTINIA TUBEROSA (Bull. *ex* Mérat) Kohn. FIG. 10.

Sclerotia borne superficially, usually on rhizomes which may be underground, irregularly shaped to globose, 10-40 × 5-30 mm, with black outer rind and white inner context; in culture, in tubes and petri plates, formed very sparsely, 1 to 4 per colony. *Sclerotial medulla* of tightly interwoven, hyaline textura oblita, cells 5-10 µm with heavily gelatinized walls 2-4 µm thick. *Sclerotial rind* a 2- to 4-cell deep layer of textura prismatica originating from medullary cells turning out perpendicularly to the surface, the outer layer of cells clavate to globose, developing carbonaceous, dark brown melanized walls, with the outermost layer more heavily melanized, forming a dense crust 4-5 µm thick. *Apothecia* arising one to several from a sclerotium, cinnamon to dark umber, usually dark at the base of the stipe; receptacle 1-3 cm broad, deeply cupulate to goblet-shaped, tapering to form a stipe 2-10 cm long × 1-2 mm thick, the lower part of which is usually covered with dark hairs in which soil particles may be trapped. *Ectal excipulum* (30-) 60-125 µm broad, of thin-walled, hyaline textura intricata, hyphae 5-15 µm wide, composed of two zones, an inner zone of textura intricata, hyphae 10-15 µm broad, and an outer zone of hyaline to light brown textura porrecta, hyphae 2-5 µm broad, parallel to the apothecial surface and giving rise to 1- to several-celled tomentum hyphae which turn out perpendicularly to the apothecial surface; tomentum hyphae on stipe dark brown-walled; both zones usually bound in gel. *Medullary excipulum* of loosely woven, thin-walled, occasionally granularly roughened, hyaline textura intricata, hyphae 2-10 µm wide; medullary excipulum of stipe with inner zone of hyaline textura porrecta parallel to the stipe axis and outer zone of granularly roughened, pale brown-walled textura intricata; sometimes bound in gel, occasionally bluing in Melzer's Reagent; often including rhomboidal crystals. *Subhymenium* 15-30 µm wide, either compact and bound in gel, or loosely interwoven, brown-walled textura intricata, hyphae 2-3 µm wide. *Asci* arising from croziers, 8-spored, cylindrical, 120-175 × 7-10 µm, with a thickened apex, pore channel wall strongly J+. *Ascospores* uniseriate, hyaline, ellipsoid, biguttulate, bi- to tetra-nucleate, 11-16(-18) × 5-8 µm. *Paraphyses* hyaline, filiform, 1.5-2 µm wide, occasionally slightly inflated at the apices, septate, simple or sparsely branched. *Microconidial state (Myrioconium)* with microconidia globose, hyaline, 2-3 (-4) µm in diameter, produced from phialides in sporodochia or solitary phialides borne laterally on hyphae, superficial on hymenium surface or culture.

Habitat: Pathogenic on rhizomes of *Anemone*, especially in Europe, but in many collections no host has been noted and the possibility exists that some strains may be saprophytic on a variety of herbaceous plants. Several collections by Whetzel and students taken near *Asarum* are filed in CUP under an unpublished epithet, "asari," but prove to be this species.

Type Locality: France.

Type Specimen: Bulliard, Hist. champ. France, tab. 485, fig. 2-3 (Iconotype). 1791.

Observations: CUP 54733 and 54734 are color variants possibly meriting recognition at infraspecific rank.

245. *Sclerotinia tuberosa* forma *pallida* P. Henn., see *Dumontinia tuberosa,* No. 244 of this list.

246. [*Sclerotinia tulipae* Boud. (ut "Lib."), Hist. classific. discomyc. Europe p. 107. 1907, *lapsus calami* for *Sclerotium tulipae* Lib.]

247. [*Sclerotinia tuliparum* P. Sydow (ut "Lendner"), Just's Bot. Jahresber. 11: 1236. 1913 ("1911"), *lapsus calami* for *Sclerotium tuliparum* Lendner.]

248. *Sclerotinia ulmariae* Velen., see *Dumontinia tuberosa,* No. 244 of this list.

249. *Sclerotinia urnula* (Weinm.) Rehm *in* Rabenh., Krypt.-Fl. Deutschl. II 1(3): 804. 1893.
≡ *Peziza urnula* Weinm., Flora 29: 455. 1832.
≡ *MONILINIA URNULA* (Weinm.) Whetzel, Mycologia 37: 673. 1945.

TYPICAL HOST: Decaying berries of *Vaccinium vitis-idaea* L.

250. *Sclerotinia utriculorum* Boud., Bull. Soc. Mycol. France 19: 196, c.ic. - 8(6). 1903.

TYPICAL HOST: Utricles of *Carex davalliana.*

NOTES: According to Dennis (1956) this is a taxonomic synonym of *Ciboria aschersoniana,* No. 44 of this list.

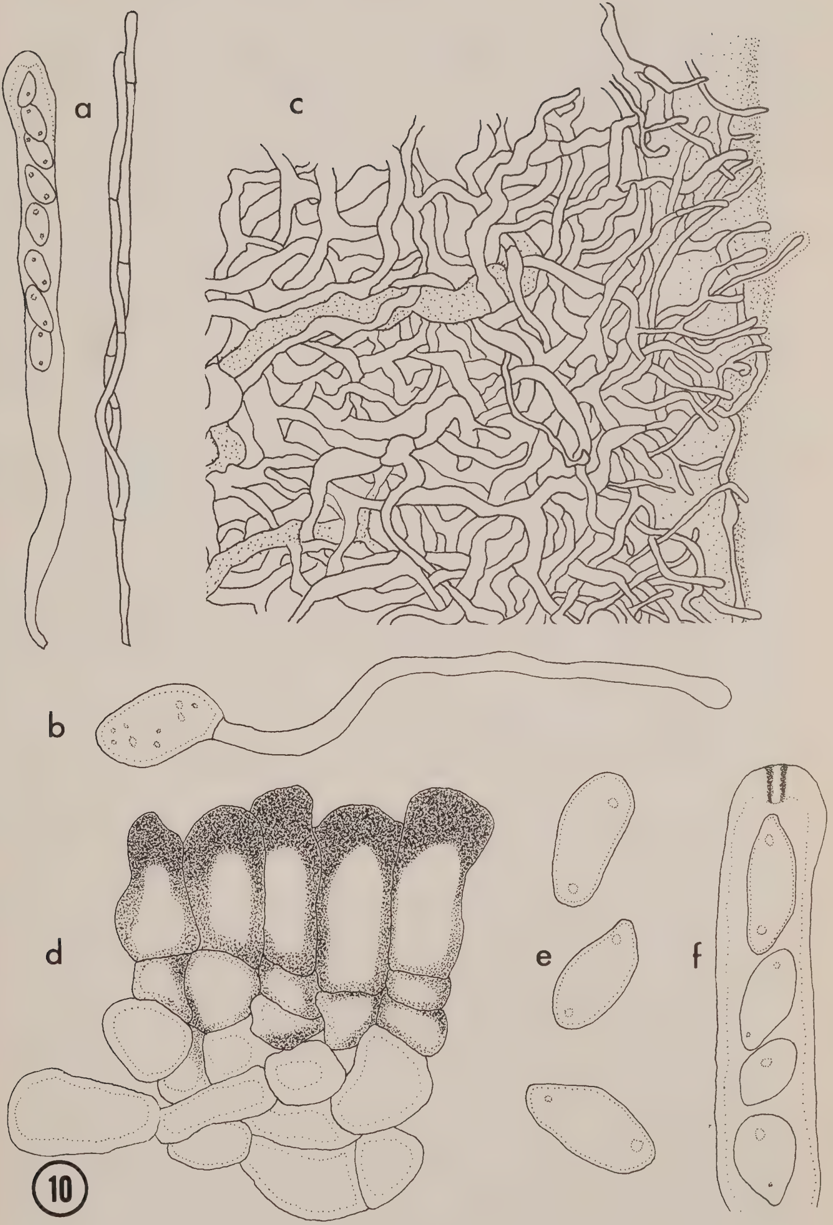
251. *Sclerotinia vaccinii* Woron., Mém. Acad. Imp. Sci. St. Pétersbourg sér. VII, 36: 3, c.ic. - I-IV. 1888.

TYPICAL HOST: Mummified berries of *Vaccinium* ("Whortleberry").

NOTES: According to Whetzel (1945) this is a taxonomic synonym of *Monilinia urnula,* No. 249 of this list.

252. *Sclerotinia vaccinii-corymbosi* Reade, Ann. Mycol. 6: 109. 1908.

FIG. 10. *Dumontinia tuberosa.* a. Ascus and paraphysis, × 500. b. Germinating ascospore, × 1500. c. Cross section through flank of apothecium showing ectal excipulum and part of medullary excipulum; medullary excipulum composed of textura intricata with occasionally granularly roughened hyphae; ectal excipulum composed of textura intricata bound in a thick layer of gel, × 500. d. Section through sclerotium showing hyaline medullary cells and rind with dense melanized outer crust composed of the walls of the outer cells, × 1500. e. Ascospores, × 1500. f. Ascus with J+ pore channel wall, × 1500. a-c, e, CUP 52881; d, Crypt. Čech. *221.*



⑩

≡ *MONILINIA VACCINII-CORYMBOSI* (Reade) Honey, Amer. J. Bot. 23: 105. 1936.

TYPICAL HOST: Twigs and mummified fruits of *Vaccinium corymbosum* L., in sphagnum.

253. *Sclerotinia vahliana* Rostr., Meddel. on Grönland 3: 607. 1891. (!!)
≡ *MYRIOSCLEROTINIA VAHLIANA* (Rostr.) Buchw., Kgl. Vet.- og Landbohøjskoles Aarsskr. 32: 156. 1949.

TYPICAL HOST: In leaves of *Eriophorum scheuchzeri* Hoppe.

SPECIMEN EXAMINED: Vahl, 5/1829 [C-Rostrup *301* (Holotype)].

254. *Sclerotinia veratri* Cash & Davidson *in* Davidson & Cash, Mycologia 25: 267. 1933. (!!) (!)

TYPICAL HOST: On *Veratrum californicum.*

SPECIMENS EXAMINED: R.W. Davidson, June 20, 1930 [BPI-Davidson *390* (Holotype)]; R.W. Davidson, June 20, 1930 [BPI-Davidson *392* (Authentic)].

NOTES: This is probably a *Botryotinia.* The fusoid to ellipsoid sclerotia are firmly attached to the host and Cash and Davidson *(loc. cit.)* note that a species of *Botrytis* developed on the sclerotia when they were incubated on damp soil.

255. *Sclerotinia veselyi* Pilát & Svrček (ut "*veselýi*"), Česká Mykol. 1: 44. 1947.

TYPICAL HOST: Preceding year's dead stems of *Equisetum limosum* L.

NOTES: The type specimen is either not available or nonexistent. This species produces longitudinally striate sclerotia within the stems of *Equisetum limosum.* On the basis of diagnosis only, this may be referable to *Myriosclerotinia.*

256. [*Sclerotinia whetzeliaňa* Wellman, Dict. trop. Amer. crops diseases p. 395. 1977, *lapsus calami* for *Whetzelinia sclerotiorum.*]

257. *Sclerotinia whetzelii* Seaver, Mycologia 32: 127. 1940 (a name change).
≡ *Sclerotinia bifrons* Whetzel, Mycologia 32: 126. 1940 (later homonym).
≡ *CIBORINIA WHETZELII* (Seaver) Seaver, North Amer. cup-fungi (inop.) p. 70. 1951.

TYPICAL HOST: On sclerotia dehisced from leaves of *Populus tremuloides.*

NOTES: This epithet is an obligate synonym of *Sclerotinia bifrons* Whetzel *non* Seaver & Shope, No. 52 of this list.

258. *Sclerotinia wisconsinensis* Rehm, see *S. sclerotiorum,* No. 1 of this list.

259. *Sclerotinia xanthorrhoeae* Beaton & Weste, see *S. sclerotiorum,* No. 1 of this list.

ACKNOWLEDGEMENTS

The financial assistance during these studies of the Department of Plant Pathology, Cornell University, a Mycological Society of America Graduate Fellowship, and an Anna E. Jenkins Postdoctoral Fellowship is gratefully acknowledged.

For providing information, making available materials, and processing loans, a debt of gratitude is owed to the following staff members of these herbaria: Dr B. Hein, B; BERN; Dr D. Farr, BPI; Dr A. Bienfait, BR; Dr B. Fredskild, C; Dr L.K. Weresub, DAOM; Dr G.C. Hedge, E; Dr D. Pfister, FH; Dr O.H. Monthoux, G; Dr P. Van der Veken, GENT; Dr T. Ahti, H; Dr F.K. Meyer, JE; Dr B.M. Spooner, K; Dr J. van Brummelen, L; Dra I. Gamundí de Amos, LPS; Dr H. Hertel, M; Dr P. Ladd, MELU; NY; PACA; Dr. J. Mouchacca, PC; Dr M. Svrček, PRM; Dr Å. Strid, S; Dr G. Forneris, TO; Dr Y. Doi, TNS; Dr R. Moberg, UPS; WU. The extra efforts of Dr Å. Strid (S) and the hospitality extended by Dr D.H. Pfister (FH) are especially appreciated. Dr Tatsuo Yokoyama, Institute for Fermentation, Osaka, provided invaluable help with the Japanese literature.

I wish to thank fellow *Sclerotinia* workers, especially Dr George Abawi, Dr Kent P. Dumont, the late Mary Elliott, Dr. Robert Lumsden, and all those who contributed isolates, for their advice, enthusiasm, and cooperation. The many fresh collections of Sclerotiniaceous fungi shared by Mr. Walter Matheis have been an important contribution to these studies.

The assistance of Mr. Howard Lyon in preparing photographic material is gratefully acknowledged. Dr William J. Dress prepared the Latin diagnoses and offered valuable editorial suggestions in the preparation of this manuscript. Deepest thanks to Prof. Richard P. Korf for his encouragement, his perceptive taxonomic and nomenclatural insights, and for his valuable editorial assistance during all phases of preparation of this manuscript.

LITERATURE CITED

ADAMS, P. B. 1979. Ecology of *Sclerotinia* species. Phytopathology (in press).

ADERHOLD, R. 1904. Über eine vermutlich zu *Monilia fructigena* Pers. gehörige *Sclerotinia*. Ber. Deutsch. Bot. Ges. 22: 262-266.

ADERHOLD, R. & W. RUHLAND. 1905. Zur Kenntnis der Obstbaum-Sclerotinien. Arbeiten Biol. Abt. Land-Forstw. K. Gesundheits. 4(5): 427-442.

BERTHET, P. 1964. Essai Biotaxonomique sur les Discomycètes. Thèse. Faculté des Sciences de l'Université de Lyon. 157 p. Berthet, Lyon.

BOUDIER, E. 1907. Histoire et classification des Discomycètes d'Europe. 221 p. Klincksieck, Paris.

BJÖRLING, K. 1942. Undersökningar rörande klöverrötan. II. Studier av utvecklingshistoria och variation hos *Sclerotinia trifoliorum*. Meddeland. Statens Växtskyddsanst. 37: 1-154.

BJÖRLING, K. 1951. Über die Entwicklungsgeschichte, Variabilität und Pathogenität von *Sclerotinia trifoliorum* Erikss. Phytopathol. Z. 18: 129-136.

BUCHWALD, N. F. 1947. Sclerotiniaceae Daniae. 1: *Ciboria, Rutstroemia, Myriosclerotinia g. n.* og *Sclerotinia*. Friesia 3: 235-330.

BUCHWALD, N. F. 1949. Studies in the Sclerotiniaceae. I. Taxonomy of the Sclerotiniaceae. Kgl. Veterinaer- og Landbohøjskoles Aarsskr. 32: 1-191.

BUCHWALD, N. F. 1954. *Ciboria batschiana* (Zopf) Buchw. [Syn. *Sclerotinia pseudotuberosa* (Rehm) Rehm]. Contribution to the discussion of the nomenclature of the species. Bot. Tidsskr. 51: 19-32.

BUCHWALD, N. F. 1956. On the dimorphism of the ascospores and their arrangement in the ascus of *Monilinia oxycocci* (Wor.) Honey [syn. *Sclerotinia oxycocci* Wor.]. Friesia 5: 196-203.

CAMPBELL, W. A. 1947. A new species of *Coniothyrium* parasitic on sclerotia. Mycologia 39: 190-195.

CHIVERS, A. H. 1929. A comparative study of *Sclerotinia minor* Jagger and *Sclerotinia intermedia* Ramsey in culture. Phytopathology 19: 301-309.

CHRISTIANSEN, M. A. 1966. Variation in apothecial structures of some Sclerotiniaceae matured under natural and artificial conditions. M.Sc. Thesis, Cornell University. 77 p.

COMMONWEALTH MYCOLOGICAL INSTITUTE. 1968. A Plant Pathologist's Pocketbook. 267 p. C.M.I., Kew, Surrey.

DENNIS, R. W. G. 1956. A revision of the British Helotiaceae in the Herbarium of the Royal Botanic Gardens, Kew, with notes on related European species. Mycol. Pap. 62: 1-216.

DENNIS, R. W. G. 1978. British Ascomycetes. xxvi + 585 p. Cramer, Vaduz.

EKSTRAND, H. 1938. Några ekonomiskt viktiga sjuksomar på höstsäd och vallväxter. Meddeland. Statens Växtskyddsanst. 25: 1-23.

ELLIOTT, M. E. 1976. *Sclerotinia kerneri*. Fungi Canadenses No. 90. 2 p.

FRANDSEN, K. J. 1946. Studies over *Sclerotinia trifoliorum* Erikss. Danske Forlag. 222 p. Copenhagen.

FUCKEL, L. 1870. Symbolae mycologicae. Beiträge zur Kenntnis der Rheinischen Pilze. Jahrb. Nassauischen Vereins Naturk. 23-24: 1-459.

GROVES, J. W. & C. A. BOWERMAN. 1955. The species of *Ciborinia* on *Populus*. Canad. J. Bot. 33: 577-590.

HAMMARLUND, C. 1932. Beiträge zur Kenntnis der Mikromycetenflora der Proviz Skåne. Ark. Bot. 25(3): 1-126.

HARA, K. 1954. A List of Japanese Fungi Hitherto Known. 447 p. Tokyo.

HARRISON, J. G. & A. J. HARGREAVES. 1977. Production and germination of *Botrytis fabae* microconidia. Trans. Brit. Mycol. Soc. 69: 332-335.

HENNEBERT, G. L. 1973. *Botrytis* and *Botrytis*-like genera. Persoonia 7: 183-204.

HENNEBERT, G. L. & L. K. WERESUB. 1977. Terms for states and forms of fungi, their names and types. Mycotaxon 6: 207-211.

HOLM, L. 1976. Some notes on discomycete nomenclature. Trans. Brit. Mycol. Soc. 67: 333-334.

HOLMGREN, P. K. & W. KEUKEN. 1974. Index Herbariorum. Part I, the Herbaria of the World, ed. 6. 397 p. Oosthoek, Scheltema & Holkema, Utrecht.

HONEY, E. E. 1928. The monilioid species of *Sclerotinia*. Mycologia 20: 127-157.

HOPKINS, E. F. 1921. The *Botrytis* blight of tulips. Cornell Univ. Agric. Exp. Sta. Mem. 45: 315-361.

JONES, D. & D. WATSON. 1969. Parasitism and lysis by soil fungi of *Sclerotinia sclerotiorum* (Lib.) de Bary, a phytopathogenic fungus. Nature 224: 287-288.

KANOUSE, B. B. 1948. The genus *Plectania* and its segregates in North America. Mycologia 40: 482-497.

KEAY, M. A. 1939. A study of certain species of the genus *Sclerotinia*. Ann. Appl. Biol. 26: 227-246.

KOHN, L. M. 1979. Delimitation of the economically important, plant pathogenic species of *Sclerotinia*. Phytopathology (in press).

KOHN, L. M. & R. P. KORF. 1975. Variation in Ascomycete iodine reactions: KOH pretreatment explored. Mycotaxon 3: 165-172.

KORF, R. P. 1952. A monograph of the Arachnopezizeae. Lloydia 14: 129-180. ('1951')

KORF, R. P. 1973. Discomycetes and Tuberales, p. 249-319, *in* G. C. Ainsworth, F. K. Sparrow, and A. S. Sussman [eds.], The Fungi. An Advanced Treatise. Vol. 4A. 621 p. Academic Press, New York.

KORF, R. P. & K. P. DUMONT. 1972. *Whetzelinia*, a new generic name for *Sclerotinia sclerotiorum* and *S. tuberosa*. Mycologia 64: 248-251.

KORF, R. P. & S. C. GRUFF. 1978. Discomycetes Exsiccati, fasc. II & III. Mycotaxon 7: 185-203.

LAWRENCE, F. H. M., A. F. GÜNTHER BUCHEIM, G. S. DANIELS, & H. DOLEZAL [eds.]. 1968. Botanico-Periodicum-Huntianum. 1063 p. Hunt Botanical Library, Pittsburg.

MORRALL, R. A., L. J. DUCZEK, & J. W. SHEARD. 1972. Variation and correlation within and between morphology, pathogenicity, and pectolytic enzyme activity in sclerotia from Saskatchewan. Canad. J. Bot. 50: 767-786.

NANNFELDT, J. A. 1932. Studien über die Morphologie und Systematik der nicht-lichenisierten inoperculaten Discomyceten. Nova Acta Regiae Soc. Sci. Upsal. [4]8(2): 1-368.

PETERSEN, R. 1978. Report of the special committee on Fungi and Lichens. Taxon 27: 543.

PURDY, L. H. 1955. A broader concept of the species *Sclerotinia sclerotiorum* based on variability. Phytopathology 45: 421-427.

PURDY, L. H. 1979. History, geographical distribution, host range, economic importance, and general symptomatology of *Sclerotinia* species. Phytopathology (in press).

RØED, H. 1954. *Mitrula sclerotiorum* Rostr. and its relation to *Sclerotinia trifoliorum* Erikss. Acta Agric. Scand. 4: 78-84.

ROSTRUP, E. 1885. Oversigt over de i 1884 idløbne forespørgsler angaaende sygdomme hos kulturplanter. Tidsskr. for Landokønomi 5: 59-80.

REHM, H. 1893. Ascomyceten: Hysteriaceen und Discomyceten, *in* Rabenhorst, L., Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz II, 1(3), Lief. 40: 785-849.

SAITO, I. 1977. Studies on the maturation and germination of sclerotia of *Sclerotinia sclerotiorum* (Lib.) de Bary, a causal fungus of bean stem rot. Rep. Hokkaido Prefect. Agric. Exp. Sta. no. 26. 106 p.

SAWADA, K. 1919. Descriptive catalogue of the Formosan fungi. Part I. Agricultural Experiment Station, Government of Formosa. Special Bulletin No. 19. 695 p.

SCHUMACHER, T. 1979. *Phialea granigena*, an older name for *Gloeotinia temulenta*. Mycotaxon 8: 125-126.

SCHWARTZ, H. F. 1974. Host range of *Whetzelinia sclerotiorum* (Lib.) Korf & Dumont [= *Sclerotinia sclerotiorum* (Lib.) de Bary]. Unpublished manuscript. 17 p.

SEAVER, F. J. 1951. The North American Cup-Fungi (Inoperculates). 428 p. Published by the author. New York.

SPROSTON, T. & D. C. PEASE. 1957. Influence of thermoperiods on production of the sexual stage of the fungus *Sclerotinia trifoliorum*. Trans. N.Y. Acad. Sci. ser. II, 20: 199-204.

STARBÄCK, K. 1895. Discomyceten-Studien. Bihang. Kongl. Svenska Vet.-Akad. Handl. 21, 3(5): 1-42.

UECKER, F. A., W. A. AYERS, & P. B. ADAMS. 1978. A new hyphomycete on sclerotia of *Sclerotinia sclerotiorum*. Mycotaxon 7: 275-282.

WATSON, A. K. & J. E. MILTIMORE. 1975. Parasitism of the sclerotia of *Sclerotinia sclerotiorum* by *Microsphaeropsis cenaureae*. Canad. J. Bot. 53: 2458-2461.

WELLS, H. D., D. K. BELL, & C. A. JAWORSKI. 1972. Efficacy of *Tricoderma harzianum* as a biocontrol for *Sclerotium rolfsii*. Phytopathology 62: 442-447.

WHETZEL, H. H. 1945. A synopsis of the genera and species of the Sclerotiniaceae, a family of stromatic inoperculate discomycetes. Mycologia 37: 648-714.

WHETZEL, H. H. 1946. The cypericolous and juncicolous species of *Sclerotinia*. Farlowia 2: 385-437.

WILLETTS, H. J. & A. L. WONG. 1971. Ontogenetic diversity of sclerotia of *Sclerotinia sclerotiorum* and related species. Trans. Brit. Mycol. Soc. 57: 515-524.

WONG, A. L. & H. J. WILLETTS. 1975. Electrophoretic studies of Australasian, North American and European isolates of *Sclerotinia sclerotiorum* and related species. J. Gen. Microbiol. 90: 355-359.

WONG, A. L. & H. J. WILLETTS. 1979. Cytology of *Sclerotinia sclerotiorum* and related species. J. Gen. Microbiol. (in press).

WORMALD, H. 1928. Further studies of the brown-rot fungi. III. Nomenclature of the American brown-rot fungi: A review of the literature and critical remarks. Trans. Brit. Mycol. Soc. 13: 194-204.

WORONIN, M. 1888. Über die Sclerotienkrankheit der Vaccinieenbeeren. Mém. Acad. Imp. Sci. St. Pétersbourg, sér. 7, 36(6): 1-47.

YLIMÄKI, A. 1968. *Mitrula sclerotiorum* Rostr., a parasite on the sclerotia of *Sclerotinia trifoliorum* Erikss. Ann. Agric. Fenn. 7: 105-106.

INDEX TO HOSTS CITED IN THE TYPE DESCRIPTIONS

FUNGI

Agaricus vellereus 419
Sclerotium semen 426; tectum 383

MUSCI

Musci (unspecified) 390, 412, 413
Campylopus atrovirens 418

VASCULAR PLANTS

Amaryllidaceae
Galanthus 410
Narcissus 419; pseudonarcissus 419; tazetta 422
Zephyranthes 419

Araliaceae
Panax quinquifolium 421

Balsaminaceae
Impatiens noli-tangere 424

Berberidaceae
Podophyllum peltatum 422

Betulaceae
Alnus 391; glutinosa 419; incana 396
Betula 395, 398; alnus v glutinosa 396

Campanulaceae
Campanula carpatica 410

Caryophyllaceae
Gypsophila elegans 426

Compositae
Carlina acaulis 391, 408
Cirsium 412
Helianthus 422; annuus 428; tuberosus 422
Lactuca sativa 386
Tragopogon porrifolius 386
Xanthorrhoea australis 383

Cornaceae
Cornus circinata 404; mas 404

Corylaceae
Carpinus 391, 395
Corylus avellana 404

Cruciferae
Arabis alpina 392
Brassica 422
Matthiola vallesiaca 383

Cyperaceae
Carex 429; ampullacea 400; aquatilis 397; arenaria 406; davalliana 434; exsiccata

421; hudsonii 406; muricata 391; prairea 417; stricta 397, 428
Eleocharis palustris 406
Eriophorum scheuchzeri 436; vaginatum 405
Schoenus nigricans 425
Scirpus caespitosus 412; lacustris 425

Empetraceae
Empetrum nigrum 407

Equisetaceae
Equisetum limosum 436

Ericaceae
Cassiope tetragona 401
Kalmia 397
Ledum 416; palustre 412
Polycodium stramineum 423
Rhododendron 397, 424
Vaccinium 397, 416, 424, 434; corymbosum 436; myrtillus 398; oxycoccus 420; uliginosum 417; vitis-idaea 420, 434

Euphorbiaceae
Ricinus communis 425

Fagaceae
Castanea 400, 401, 413; vesca 406
Fagus 398, 416
Quercus 391, 416, 423; pediculata 398, 423

Geraniaceae
Geranium maculatum 410
Pelargonium 422

Gramineae
Agrostis 413
Bambusa vulgaris 419
Bromus erectus 411
Dactylis glomerata 398
Festuca 413; gigantea 407
Hordeum 413
Phalaris arundinacea 417
Phragmites communis 416
Poa 413; pratensis 383
Secale cereale 411, 426, 428
Triticum 394; vulgare 411

Iridaceae
Gladiolus 406, 410
Iris 404

Juglandaceae
Juglans 414

Juncaceae
Juncus 414; compressus 414; conglomeratus 404
Luzula pilosa 417

Labiatae
Galeopsis versicolor 383
Ocymum basilicum 420

Leguminosae
Arachis hypogaea 386, 393, 397
Melilotus 386
Trifolium 390; repens 427
Vicia faba 394

Liliaceae
Allium 422; cepa 396, 428; fistulosum 396; porri 423; triquetrum 427; ursinum 411
Erythronium albidum 411; americanum 407
Hyacinthus 391
Polygonatum 426; multiflorum 424
Smilacina racemosa 426
Tulipa 386, 421
Veratrum californicum 436

Magnoliaceae
Magnolia glauca 411

Moraceae
Cannabis 383
Morus alba 400, 418, 426

Myrtaceae
Myrtaceae (unspecified) 383, 419

Nyssaceae
Nyssa multiflora 420

Oleaceae
Ligustrum 427

Orobanchaceae
Orobanche cernua 383

Pinaceae
Abies douglasii 405; pectinata 415
Cryptomeria japonica 393
Sequoia gigantea 405

Polygonaceae
Fagopyrum esculentum 392
Polygonum aviculare 423
Rumex 418

Pyrolaceae
Pirola chlorantha 393; media 393; minor 393; rotundifolia 393; uniflora 393

Ranunculaceae
Aconitum napellus 395
Anemone nemorosa 430; ranunculoides 430
Caltha palustris 399
Ficaria verna 408
Paeonia 421
Ranunculus ficaria 383; septentrionalis 424

Rosaceae
Rosaceae (unspecified) 396, 409
Amelanchier canadensis 396; cusickii 411
Amygdalis 409
Crataegus 404, 414
Cydonia japonica 401; vulgaris 405
Malus 395, 417

Mespilus 417; germanica 417
Persica vulgaris 408
Potentilla 407
Prunus 402, 408, 409; armeniaceae 416; cerasus 401, 402; communis 409; demissa 405; domestica 402; dulcis 402; mume 418; padus 420; persica 402, 408; pseudocerasus 416; serotinus 425; spinosa 402, 427; virginiana 397
Pyrus communis 408; malus 409, 422
Rubus fruticosus 394
Sorbus aria 397; aucuparia 397
Spiraea ulmaria 430

Salicaceae
Populus tremuloides 398, 403, 436
Salix 408, 424, 425

Scrophulariaceae
Pedicularis groenlandica 403
Veronica hederifolia 422

Solanaceae
Nicotiana tabacum 393
Solanum tuberosum 383, 427

Theaceae
Camellia 399; japonica 399

Tiliaceae
Tilia americana 429

Umbelliferae
Apium graveolens 386

Vitaceae
Vitis vinifera 409

INDEX TO GENERA, SPECIES, AND INFRASPECIFIC TAXA

New taxa are in CAPITALS, and the pages where they are published are in *italics*.

Acrosporium fructigenum 408
Amphobotrys ricini 425

Botryotinia 369, 373, 375, 377, 395, 403, 407, 413, 420, 422, 424, 427, 436; allii 395; arachidis 397; calthae 399; convoluta 404; draytoni 405; draytonii 405; ficariarum 408; fuckeliana 409; globosa 411; moricola 418; narcissicola 419; pelargonii 422; polyblastis 422; porri 423; ranunculi 375, 424; ricini 425; sphaerosperma 427; squamosa 428
Botrytis 369, 403, 410, 413, 421, 424, 425, 436; cinerea f ocymi 420; douglasii 405; fabae 368; galanthina 410; paeoniae 420; parasitica 421; tulipae 421

Ciboria 375, 377, 401, 402, 416, 419, 424, 428; aestivalis 395; alni 396; aschersoniana 397, 434; batschiana 398, 423; betulae 398; carunculoides 400; ciborioides 402, 429; ciborioides f tenella 429; coryli 404; friesii 402; friesii subsp tenella 429; fructicola 408; johnsonii 414; juglandis 414; juncigena 414; linhartiana 405; nyssaegena 420; nyssogena 420; polygoni 423; plöttneriana 422; ploettneriana 422; pseudotuberosa 401, 423; shiraiana 426; subularis 428; temulenta 426; tenella 429; tiliae 429
Ciborinia 365, 369, 370, 373, 375, 378, 395, 403, 405, 407, 410, 413, 415, 421, 424, 429, 432; allii 368, 375, 395; bifrons 398, 403; CAMELLIAE 375, *399*; candolleana 369, 400; confundens 403; erythronii 375, 407; folicola 408; gracilipes 411; gracilis 411; hirtella 413; pseudobifrons 375; seaveri 398, 403; whetzelii 436

DUMONTINIA 365, 370, 372, 375, 378, *432*; TUBEROSA 375, 376, 383, 413, 430, *432*, 433, 434

ELLIOTTINIA 365, 377, *415*, 432; KERNERI *415*
Epidochium affine 406; ambiens 406

Geopyxis pocula 393
Gloeotinia 377, 411; granigena 411, 426, 429; temulenta 411, 428

Helotium sclerotiorum 378, 383
Hymenoscypha 392; sclerotiorum 379; tuberosa 430
Hymenoscyphus filipes 392; tuberosus 430

Lambertella 375, 404, 411, 412, 418; viburni 412
Lanzia 401, 404, 406, 411, 413, 418, 428

Macroscyphus tuberosus 430
Martininia 377
Microstoma hiemalis 413; protracta 398, 413
Mitrula sclerotiorum 378
Moellerodiscus 399, 413
Monilia 401; albo-lutea 419; cinerea 402; cinerea f americana 396; cinerea f mali 403; cinerea f pruni 403; fructigena

408; kusanoi 416; linhartiana 405; polycodii 423
Monilinia 368, 370, 377, 401, 408, 409, 418; amelanchieris 396; ariae 397; aucupariae 397; baccarum 398; cinerea 402; corni 404; cydoniae 405; demissa 405; empetri 407; fructicola 397, 408; fructigena 408, 409; gregaria 411; johnsonii 404, 414; kusanoi 415; laxa 401, 402, 403, 416; ledi 401, 412, 416; linhartiana 405; mali 417; megalospora 417; mespili 417; mume 418; oxycocci 420; padi 397, 420; polycodii 423; rhododendri 424; seaveri 425; urnula 434; vaccinii-corymbosi 436
Myrioconium 369, 370, 377, 382, 385, 388, 390, 401, 433
Myriosclerotinia 370, 373, 375, 378, 391, 397, 402, 406, 407, 412, 414, 417, 428, 436; borealis 375, 398, 407, 411; caricis-ampullaceae 400; curreyana 404, 414; dennisii 375, 405; duriaeana 406; juncifida 414; longisclerotialis 417; scirpicola 412, 425; sulcata 375, 406, 428; vahliana 397, 436

Octospora tuberosa 429, 430
Oidium laxum 416
Ovularia 417, 425
Ovulinia azaleae 397; perplexa 422

Peziza 430, 431; brevipes 391; bulborum 391; candolleana 400; ciborioides 387, 390, 401; curreyana 404; duriaeana 406; echinophila 406; friesii 401; fuckeliana 409; gracilipes 411; incondita 413; juglandis 414; juncifida 414; kauffmanniana 379, 383, 384; kerneri 414, 415; libertiana 383; linhartiana 405; mycetophila 418; nyssaegena 420; pocula 393; pseudotuberosa 423; rapulum 424; sclerotiacea 394; sclerotii 379; sclerotiorum 378; seminis 426; spinosae 427; subularis 428; temulenta 428; tuba 394; tubaeformis 394; tuberosa 429, 430, 431, 432; tuberosa α nigra 430; urnula 434
Phaeoscherotinia 422
Phaeosclerotinia 377, 422; nipponica 420, 422; phaeospora 422
Phialea capillipes 391; granigena 411; sclerotiorum 379; temulenta 428; tuberosa 430
Poculum 408, 418, 428
Pycnopeziza 377

Rhacodiella 401; castaneae 401
Rutstroemia 375, 402, 429, 431; adusta 395; baccarum 398; ciborioides 402; ciborioides f tenella 402, 429; echinophila 406; homocarpa 379, 383, 384; lindaviana 416; nervisequa 419; paludosa 421; pruni-spinosae 427; tuberosa 430, 431

Sarcoscypha protracta 369
Scleromitrula 377, 426; shiraiana 426
Sclerotinia 365-378, 392, 396, 400, 402, 408-410, 412, 414-416, 418-420, 422, 425, 427-430, 432; aconitincola 395; acutispora 395; adusta 395; adjusta 395; aestivalis 395; allii 395; alni 396; amelanchieris 396; americana 396; angustior 397; arachidis 397; arctica 397; ariae 397; aschersoniana 397; aucupariae 397; azaleae 397; baccarum 398; baccata 369, 398, 413; batschiana 398; betulae 398; bifrons 398, 403, 436; borealis 398; bresadolae 391; brevipes 391; brunneocarpa 399; bryophila 387, 390, 399; bulborum 391; calthae 399; camelliae 365, 399; candolleana 369, 370, 400; candolleana var hirtella 413; candolleana var hirtellum 413; capillipes 391, caricina 391; caricis-ampullaceae 400; carlinae 391; carnea 400; carpini 391; carunculoides 400; cassiopes 401; castaneae 401; caudada 379, 384, 401; cerasi 401; chaenomelis 401; ciborioides 401, 408, 429; cinerea 402; cinerea f americana 396; cinerea f avium 403; cinerea f cerasi 403; cinerea f mail 403, 416; cinerea f pruni 403; coloradensis 403; confundens 398, 403; convoluta 404; corni 404; coryli 404; crategi 404; culmifida 404; curreyana 404, 414; cydoniae 405; cylindrica 405; demissa 405; dennisii 405; douglasii 405; draytoni 405; draytonii 405; dubia 392; duriaeana 406; duriaeana f affine 406; duriaeana f ambiens 406; duriaeana f duriaeana 406; echinophila 406; eleocharidis 406; empetri 406; empetri f sclerotifera 406, 407; eriophori 407; erythronii 407; fagopyri 392; fallax 407; festucae 407; ficariacearum 408; ficariae 379, 383, 384, 408; filipes 392, 421; foliicola 408; fredericae 408; friesii 402, 408; fructicola 408; fructigena 408, 409, 420; fuckeliana 369, 409; fuckeliana var jeanperli 392; galanthi 410; galeopsidis 379, 383, 384, 410; geranii 410; gladioli 410; glandicola 410; globispora 410; globosa 411; gracilipes 411; gracilis 411; graminearum 411; granigena 411; gregaria 411; gregoriana 412; hartii 412; helvelloidea 392; henningsiana 379, 383 384, 412; herbiseda 412; heterocarpa 412; heteroeca 412; heteroica 412; hiemalis 412, 413; hirtella 413; momoeocarpa 319, 413; hordei 413; hyemalis 413; incondita 413; infundibuliformis 413, 430, 431; intermedia 372, 384, 386, 414; johanssonii 392; johanssonii f sclerotifera 392; johnsonii 414; juglandis 414; juncifida 414; juncigena 414; kenjiana 414; kerneri 365, 414; kirschsteiniana 393; kitajimana 393; kusanoi 415; laxa 402, 416, 428; laxa f mali 403, 416; ledi 416; lentiformis

416; levi 416; libertiana 369, 379, 383, 416, 431; lindaviana 416; longisclerotialis 416; luzulae 417; mali 417; malicola 417; matthiolae 379, 383, 384, 417; megalospora 417; menieri 417, 418; mespili 417; microspora 418; minor 365, 371-376, 378, 382, 384, 386, 387, 414, 425; miyabeana 393; moelleriana 379, 383, 384, 418; monieri 418; moricola 418; mume 418; muscorum 418; mycetophila 418; mystaceae 419; myrtaceae 419; narcissi 419; narcissicola 419; nervisequa 419; nervisequa v bambusacea 419; nicotianae 393; nigricans 419; nigromarginata 393; niponica 420; nortoniana 420; nyssaegena 420; ocymi 420; opuntiarum 379, 383, 420; oreophila 420; oxycocci 420; padi 420; paeoniae 420; pallida 421; paludosa 421; panacis 421; parasitica 421; paridis 421; pelargonii 422; perplexa 422; phaeospora 422; phormi 422; pirolae 393; ploettneriana 422; pocula 393; podophyllina 422; polyblastis 422; polycodii 423; polygoni 423; porri 423; postuma 379, 383, 384, 423; pruni 423, 427; pruni-spinosae 423, 427; pseudotuberosa 423; pustula γ castaneae 423; ranunculi 424; rapulum 424; rathenowiana 424, 425; rehmiana 424; rhododendri 424; richteriana 424; ricini 425; riograndensis 379, 383, 384, 425; rolfsii 425; rubi 394; salicina 425; sativa 385, 386, 425; schoenicola 425; scirpicola 425; sclerotiacea 394; sclerotiorum 365, 366, 369-384, 390-394, 401, 408, 410, 412, 416-418, 420, 423, 425, 436; sclerotiorum var opuntiarum 379, 425; sclerotiorum var orobanches 379, 383, 384, 425; seaveri 425; secalincola 426; seminis 426; serica 426; shiraiana 426; smilacinae 426; solani 427; spermophila 427; sphaerosperma 427; spinosae 423, 427; spinosae var minor 427; spinosae var pallida 427; squamosa 428; subularis 428; sulcata 406, 428; taxa 428; temulenta 428; tenella 429; tenuispora 429; tiliae 429; trifolii 387, 429; trifoliorum 365, 366, 371-376, 378, 387-390, 392, 394, 399, 402, 429; trifoliorum var fabae 394; trifoliorum var minor 429; tuba 394; tuberosa 365, 369, 370, 372, 394, 429; tuberosa f pallida 430, 434; tulipae 434; tuliparum 434; ulmariae 430, 431, 434; urnula 434; utriculorum 434; vaccinii 434; vaccinii-corymbosi 434; vahliana 436; veratri 436; veselyi 436; veselyí 436; vesicaria 394; whetzeliana 379, 436; whetzelii 398, 436; wisconsinensis 379, 383, 384, 436; xanthorrhoeae 379, 383, 436
Sclerotiopsis pelargonii 422; phormi 422
Sclerotium 417, 425; compactum 383; fallax 407; gladioli 410; nigricans 419; pustula γ castaneae 424; rolfsii 425; semen 426; sulcatum 428; tectum 382; tulipae 421, 434; tuliparum 434
Seaverinia geranii 410
Septoria culmifida 404
Septotinia 377; podophyllina 422
Stromatinia 369, 378, 393; gladioli 410; linhartiana 405; narcissi 419; panacis 421; paridis 421; pirolae 393; rapulum 424, 425, 426; serica 426; smilacinae 426

Torula fructigena 408
Typhula 421, 426

Urnula hartii 412

Verpatinia 378; calthicola 399
Verrucobotrys geranii 410

Whetzeliana sclerotiorum 379
Whetzelinia 370, 377; sclerotiorum 379, 436; tuberosa 430

MYCOTAXON

Vol. IX, No. 2, pp. 445-450 July-September 1979

HYPOGEOUS ASCOMYCETES IN ALBERTA, CANADA WITH TWO NEW NORTH AMERICAN RECORDS

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SUMMARY

Geopora clausa subsp. *clausa* f. *clausa* and *Elaphomyces leveillei* are reported for the first time from North America. Mycorrhizal associates and distribution of these two species and *G. cooperi* f. *gilkeyae*, *E. granulatus* var. *granulatus* and *E. muricatus* in Alberta are discussed.

The hypogeous ascomycetes are of special interest in that they are mycorrhizal associates of a variety of woody plants (Trappe, 1971). Difficulty in culturing this ecological group of fungi has largely precluded obtaining the classical experimental confirmation of mycorrhizal relationships but empirical evidence indicates that these fungi are important symbionts of forest trees. Precise data on distribution and occurrence should aid in the elucidation of the ecology and importance of hypogeous ascomycetes in forest ecosystems. This note reports on the distribution and host relationships of five species of hypogeous fungi found in north temperate forests. Representive collections of all taxa have been deposited at the Biosystematics Research Institute (DAOM), Ottawa, Canada. Color notations are either reported in general terms or according to Henderson *et al.* (1969). If the latter, it is indicated by an asterisk following the color name.

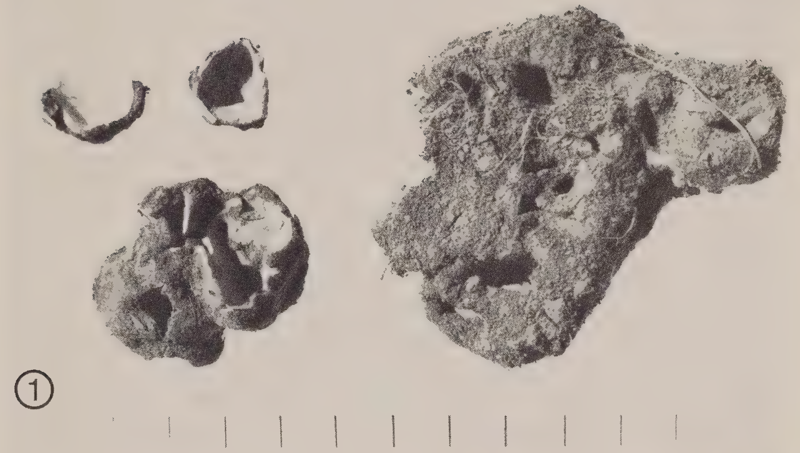
Geopora clausa (Tul. & Tul.) Burdsall subsp. *clausa* f. *clausa*

A single collection (RMD 1279) was found as the ascocarps bulged and cracked the soil in a newly planted lawn in the Pearce Estate area (51°2'30"N, 114°0'50"W) of Calgary, Alberta, September 14, 1973. The ascocarps were firmly bound to the soil by excipular hairs and were clustered tightly together (Fig. 1). The only possible mycorrhizal host was mature *Populus balsamifera* about 2 m distant.

Macroscopic and microscopic features generally agreed with the description given by Burdsall (1968) with two exceptions. The outer cells of the peridium of RMD 1279, had a maximum diameter of 20 µm whereas Burdsall described a range of 15-45 µm for *G. clausa* f. *clausa*. This cell size more closely resembles *G. clausa* spp. *californica*. The length of the spores of the two subspecies as described by Burdsall is similar but the width varies resulting in a difference in L/W ratios. Burdsall reported L/W ratios of 1.3 for *G. clausa* spp. *californica*, 1.4-1.5 for *G. clausa* f. *clausa* and 1.7-2.0 for *G. clausa* f. *ellipsospora*. Measurements of 30 spores of RMD 1279 gave a L/W ratio of 1.5-1.7 (2.1). The L/W ratio of RMD 1279 falls between *G. clausa* f. *clausa* and f. *ellipsospora* and is much greater than *G. clausa* spp. *californica*. The final decision to place the collection in *Geopora clausa* f. *clausa* was based on the consistant presence of one large oil drop in each spore in RMD 1279 which is in agreement with Burdsall's observation. *G. clausa* f. *ellipsospora* was described by Burdsall as biguttulate. Thus RMD 1279 was somewhat intermediate but the spores were consistantly narrower than *G. clausa* spp. *californica* [13-16(18) vs. 16-20(21) µm] and the uniguttulate condition separated it from *Geopora clausa* f. *ellipsospora*. Additional observations may reveal other intermediate forms.

Geopora cooperi Harkn. f. *gilkeyae* Burdsall

Four collections (RMD 2102 and others) were made in the vicinity of Bow Valley Provincial Park near Seebe in the central foothills region of Alberta. Collections were made between August 2 and 14 in 1976 and 1977 in or near excavations presumably made by red squirrels (*Tamiasciurus hudsonicus*). Three collections were made in mixed stands of *Picea glauca* and either *Populus tremuloides* or *Populus balsamifera* and the fourth in a *Pinus contorta* - *Pseudo-*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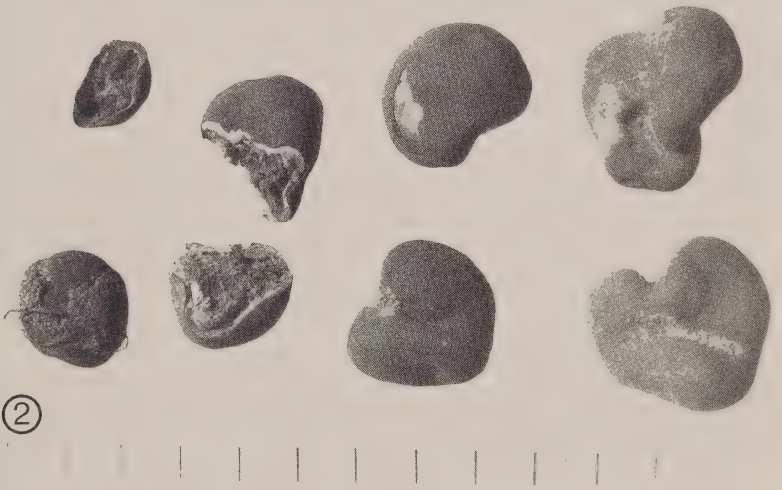
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Fig. 1 Ascocarps of *Geopora clausa* subsp. *clausa* f. *clausa*

Fig. 2 Ascocarps of *Elaphomyces leveillei*. Scale in centimeters

tsuga menziesii stand. All specimens closely matched the description given by Burdsall (1968).

Elaphomyces leveillei Tul. & Tul.

Two collections were made about 30 km north of Fort McMurray, Alberta (56°57'N, 111°26'W) in sandy soil beneath the soil-forest floor interface. RMD 1477 occurred 2 m from a clump of *Betula papyrifera* with *Vaccinium myrtilloides* and *Cornus canadensis*. RMD 1478 was found 10 m from the first collection and was within 1 m of *B. papyrifera* and *Alnus crispa*.

This species was identified by J.M. Trappe who compared it with European collections and informed me it matched in all details. Trappe (Pers. comm.) also stated that it has been found previously in France, Italy and Hungary. In that it has not been recently described, a brief description follows.

Ascocarps subglobose with irregular depressions, 15-30 mm broad, external hyphae usually absent except for a small lemon yellow* to sulphur yellow* spot in a depressed area (Fig. 2). Peridium fuscous black*, finely warted, hard when dry, two-layered, outer layer black and readily flaked off exposing the gray inner layer. Fertile areas scattered, 2 mm in diameter; when mature contents olivaceous black*, powdery, glebal hyphae abundant.

Superficial peridial hyphae yellowish to yellow-brown, 3.5-5 µm diameter, septate, branched, walls 0.3-0.5 µm and loosely covered with yellow to yellow-brown amorphous material. Outer peridial wall 250-350 µm thick, elements fused together, brown, walls irregularily thickened to 1.5-2.5 µm, stellate-*Cenococcum* type of anatomy (Trappe, 1971). Inner peridial layer about 1 mm thick, distinct from outer layer, hyphae tightly interwoven, 5-6 µm diameter, walls 1-1.5 µm thick, hyaline becoming pale ochraceous near outer layer.

Asci nearly globose, 50-55 µm diameter, 8-spored, wall thin and evanescent. Spores (21)24-26.5 µm including ornamentation, globose, umber*, verruculose and patches of ornaments becoming separated in an irregular pattern, ornaments 1-1.5 µm high, 1-guttulate, nonamyloid. Glebal hyphae hyaline, 1.5-3.5 µm diameter, smooth, septate, walls slightly thickened to 0.5 µm.

Elaphomyces muricatus Fr. var. *muricatus*

Seven collections (RMD 1997 and others) were made between June 17 and June 21 and one collection on August 12 in sandy soils in northern Alberta near the Richardson Fire Tower, 57°53'N, 110°58'W. The soils ranged from moderately dry to moist. *Pinus banksiana* occurred near all collection points and *Betula papyrifera* near five. *Populus tremuloides* and *Alnus crispa* were close to points where *Betula* was absent. *E. muricatus* was never found in the drier, pure pine-lichen woodlands where *E. granulatus* was most common. The differences in occurrence could be due to a strict mycorrhizal association with hardwoods or a preference for moister and cooler soils by *E. muricatus*. Eckblad (1962) considered this species to be primarily associated with *Betula* in Norway. Trappe (Pers. comm.), however, has found it to be abundant in pure conifer stands, often associated with *Tsuga heterophylla* or *T. mertensiana*.

Elaphomyces granulatus Fr. var. *granulatus*

Seven collections in different areas (RMD 2002 and others) were made between June 18 and June 23, four on August 11 and one September 25 at the Richardson Fire Tower site. All of the collections were referable to the variety *E. granulatus* var. *granulatus sensu* Fogel and Trappe (1976) on the basis of the spores possessing spines 2-2.5 μm long. The ornamented layer was easily observed following treatment with 10 or 25% household bleach which removed the dark pigments and revealed the outer layer of radially oriented rods which coalesce to form the spines. Up to 16% of the spores turned dark green after the bleach treatment. The reaction was inconsistent and was not related to the size of the ascocarps or the severity of the treatment.

Pinus banksiana was associated with all the collections and most collections were made in open, dry, jack pine-lichen (*Cladina mitis*) stands where other woody plants were widely scattered. The only other possible mycorrhizal hosts were *Arctostaphylos uvi-ursi*, *Betula papyrifera* and *Populus tremuloides*.

Both *E. granulatus* and *E. muricatus* occurred only in mature stands and were never found in disturbed soils along roadsides where *Rhizopogon rubescens* Tul. was common. It may be that *Elaphomyces* species are very slow growing in nature and require a long period of time to develop a vegetative base sufficient for ascocarp production.

All the collections of *Elaphomyces* at the Richardson Fire Tower were located by digging where squirrels had been searching for hypogeous fungi. Digging by squirrels was common in June but relatively rare at the two latter dates. It is likely that the change in digging activity was due to the absence of fleshy agarics in June and their abundance later in the year when squirrels were observed feeding on the epigeous flora.

ACKNOWLEDGMENTS

The collections of *E. leveillei* were made on a project funded by Syncrude Canada Limited. Collection of the other species of *Elaphomyces* were made possible by funding from the Alberta Oil Sands Environmental Research Program. A special thanks to J.M. Trappe for identification of *E. leveillei* and *E. granulatus* and for confirming identification of the other species treated here.

LITERATURE CITED

Burdsall, H.H., Jr. 1968. A revision of the genus *Hydnocyctis* (Tuberales) and of the hypogeous species of *Geopora* (Pezizales). *Mycologia* 60:496-525.

Eckblad, F-E. 1962. Studies in the hypogaean fungi of Norway. II. Revision of the genus *Elaphomyces*. Nytt Mag. Bot. 9:199-210.

Fogel, R. and J.M. Trappe. 1976. Additions to the hypogeous mycoflora of Colorado. I. Ascomycetes. Mycotaxon 4:211-217.

Henderson, D.M., P.D. Orton and R. Watling. 1969. British fungus flora - Agarics and Boleti: Introduction. Royal Botanic Garden, Edinburgh, 58 pp.

Trappe, J.M. 1971. Mycorrhiza-forming Ascomycetes, P. 19-37. *In* E. Hacskaylo (ed.), Mycorrhizae. U.S. Dept. Agr. Misc. Publ. 1189, 255 pp.

MYCOTAXON

Vol. IX, No. 2, pp. 451-458 July-September 1979

HYPOGEOUS FUNGI OF MINNESOTA: GENEA ANTHRACINA SP. NOV.

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The genus *Genea* Vitt. was differentiated from others in the Geneaceae (2) by the presence of a basal mycelial tuft, a single ascocarp opening, and ellipsoidal or subglobose ornamented spores. Gilkey (1) recognized a close phyletic line between *Genea, Myrmecocystis* Harkn. and *Genabea* Tul. These genera have roughly globose, hollow ascocarps with one or more openings (2). *Genea* spp. have a basal mycelial tuft; *Myrmecocystis* and *Genabea* do not. *Myrmecocystis* and *Genabea* were separated primarily on hymenial characters. The hymenial region of *Myrmecocystis* was held to be interrupted by sterile zones of paraphyses, while that of *Genabea* was interrupted by zones of pseudoparenchyma. Gilkey (3) predicted retention of all three genera might prove untenable as new data became available. Emphasizing ascocarp morphology Korf (5) accepted *Genea* in the broad sense including species formerly placed in *Myrmecocystis* and *Genabea.* Trappe (6) has retained *Genea,* placing *Myrmecocystis* in synonomy with *Genabea.* His conclusion has the virtue of eliminating a superfluous genus in *Myrmecocystis* while retaining *Genabea* which appears both taxonomically and phyletically defensible. Trappe (6) has summarized the means by which *Genea* and *Genabea* can be readily differentiated:

Genea:	spores verrucose, uniseriate; asci cylindric; hymenia only occasionally interrupted by sterile zones of paraphyses.
Genabea:	spores echinulate, uniseriate, biseriate or randomly arranged; asci clavate to ellipsoid; hymenia regularly separated into

pockets by sterile zones of paraphyses or isodiametric cells.

While investigating mycorrhizal fungi of Northern Minnesota we recently collected a new *Genea* species.

Anatomical features were described from fresh and dried sections mounted in lactophenol, 5% KOH, Melzer's reagent, and cotton blue-lactic acid. Spore ornamentation was not described from 5% KOH mounts. Arithmetic means of ascospores are based on 50 observations. Tissue type terminology is that of Korf (4). Color names enclosed in quotation marks are those of Ridgway (5). Collections have been deposited in the Plant Pathology Mycological Herbarium, University of Minnesota (MPPD), and the Mycological Herbarium of Oregon State University (OSC).

Genea anthracina Heblack and Stewart sp. nov. Figs. 1-10

Fructificationes vivae 3-6 x 5-11 mm, anthracinae, subglobosae vel irregulares, verruculosae; raro hispidae; caespitulo basali myceliali. Excipulum externum texturae angularis 5-40 (-48) μm diam; excipulum internum texturae globosae - epidermoidae 4-15 (-33) μm diam; epithecium corticalis texturae angularis 5-40 μm diam. Asci cylindrici 150-225 x 22-32 μm, octospori. Sporae ellipsoideae 22-26 x 18-20 μm (sine ornamentis), 28-32 x 20-24 μm (ornamentis), papillis. Paraphyses 2-6 μm diam, septatae; hymenio continuo. Holotypus Stewart-3651 (MPPD).

ETYMOLOGY: Latin, *anthracina* (coal black) referring to fresh sporocarp color.

Fresh *sporocarps* 3-6 x 5-11 mm mostly hollow but a few chambered due to infolding of wall; apical orifice glabrous, concolorus with sporocarp surface; with a basal mass of "clay" colored mycelium; surface "black", moderately convoluted, subglobose to flattened-subglobose, verrucose, the verrucae rarely with short to elongate septate hairs 4-7 μm diam; interior a "black" verrucose epithecium; verrucae rarely with short to elongate septate hairs 4-7 μm diam. *Asci* in a continuous hymenium among paraphyses; asci 150-225 x 22-32 μm, 8-spored, cylindric, somewhat constricted between spores, abruptly tapering past the basal spore to a croziered base 3-6 μm broad; walls mostly 0.5 μm thick along entire length; bases deeply embedded in the subhymenium. *Paraphyses* (2-) 3-4 (-6) µm diam, hyaline, thin-walled, cylindric, if inflated at septa, then only slightly so. *Ascospores* excluding ornamentation 22-26 x 18-20 µm ($\bar{x}$: 24 x 19 µm), including ornamentation 28-32 x 20-24 µm ($\bar{x}$: 29 x 22 µm), ellipsoid, with crowded papillae. *Papillae* 0.5-3.8 (-9) µm diam, 0.5-4 µm high, hemispherical, occasionally irregularly subglobose in optical cross section, apical regions of major papillae mostly with accessory minute minor papillae; surface ornamentation strongly cyanophilic and dissolving in KOH. *Ectal excipulum* 65-200 µm thick, a textura angularis of cells 5-40 (-48) µm diam, exposed cells with "orange rufous" colored walls viewed singly, "black" in mass; walls up to 14 µm thick; inner cells nearly hyaline, walls 0.5-2 µm thick; *medullary excipulum* 50-125 µm thick, a textura globosa-epidermoidea of hyaline cells 4-15 (-33) µm diam; *epithecium* a secondary cortex of fused paraphyses 100-200 µm thick, a textura angularis of cells 5-40 µm diam, of exposed cells with walls up to 14 µm thick, and hyaline cells with walls 0.5-2 µm thick near the hymenium; color of epithecial cells that of ectal excipulum.

DISTRIBUTION: Known only from the holotype and paratype collections. Hypogeous, solitary to gregarious; in a predominantly *Pinus resinosa* Ait. forest, with *Betula papyrifera* Marsh., and *Corylus cornutus* Marsh. A probable mycorrhizal symbiont.

COLLECTIONS EXAMINED: Holotype: U.S.A., Minnesota, Hubbard Co., 47^{o} 11' N., 95^{o} 10' W., 472 m elev., in deer exclusion area about 300 m E. of Mary Lake, Itasca State Park; 12 Aug. 1978. Stewart #3651. Isotype: Stewart #3651 (OSC). Paratype: U.S.A., Minnesota, Hubbard Co., 47^{o} 11' N., 95^{o} 10' W., 472 m elev., same location as holotype; Stewart #3650 (MPPD).

OBSERVATIONS: *Genea anthracina* superficially resembles *Genea gardneri* Gilkey but differs by having an uninterrupted hymenium and a larger spore length-width ratio. Among those species with an uninterrupted hymenium *Genea thaxteri* Gilkey appears most like *G. anthracina* in spore size, but differs in several details as shown in the following summary.

	Genea anthracina	*Genea thaxteri*
ascocarp color	coal black	"Sudan brown"
spore size	28-32 x 20-24 μm	26-28 x 20-22 μm
spore ornamentation	Epispore, papillae mostly hemispherical, never pointed	Mostly rounded, or somewhat pyramidial

To our knowledge *G. anthracina* is the first *Genea* species reported from Minnesota.

ACKNOWLEDGEMENTS

The initial phase of this research was completed at the University of Minnesota Lake Itasca Forestry and Biology Station. We appreciate the assistance provided by Mary Palm in collecting Minnesota hypogeous macromycetes. The comments of Drs. H. Burdsall, A. Rossman and J. Trappe regarding the manuscript and new *Genea* species are appreciated. This research was supported in part by funds provided by USDA Forest Service, North Central Forest Experiment Station, RWU NC-2205, University of Minnesota Graduate School grant to the senior author and the Agricultural Experiment Station. Minnesota Agricultural Experiment Station, Scientific Journal Series, Paper No. 10,681.

LITERATURE CITED

1. Gilkey, H. M. 1954. Taxonomic notes on Tuberales. Mycologia 46:783-793.

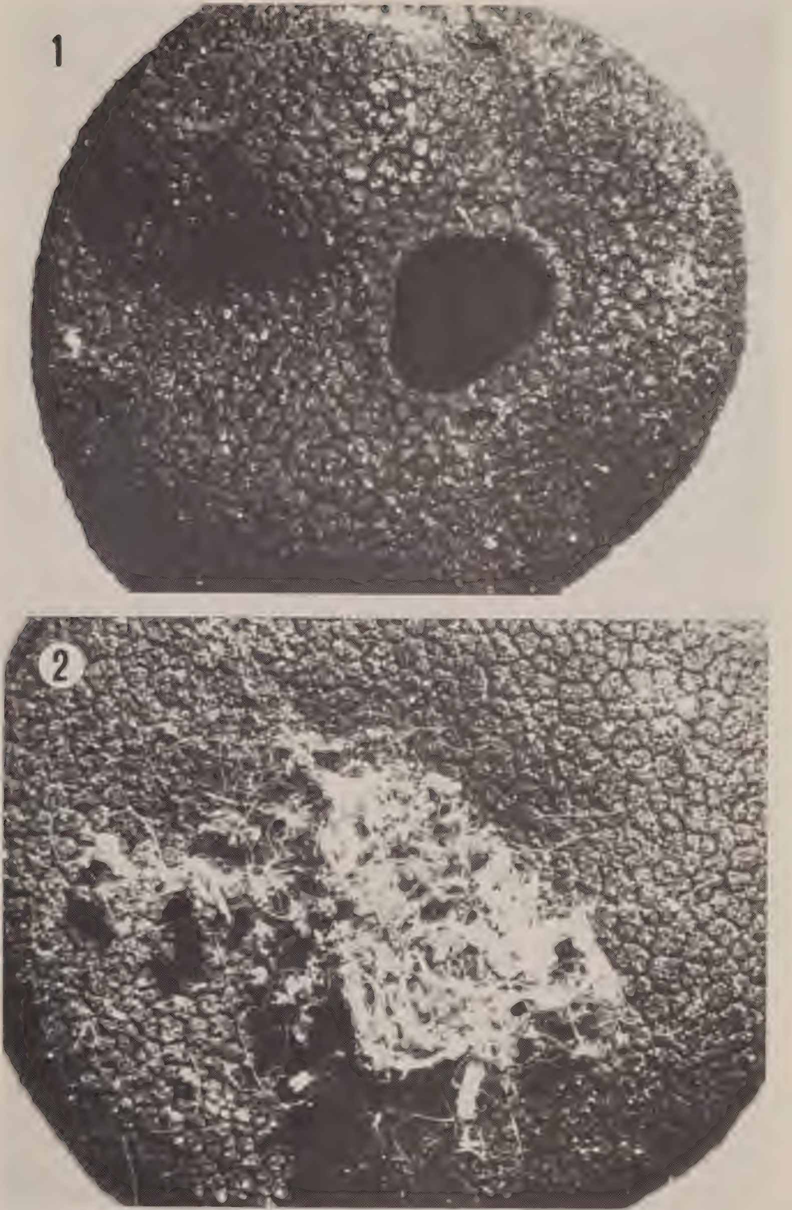
2. Gilkey, H. M. 1954. Tuberales, N. Am. Flora ser. 2, 1:1-36.

3. Gilkey, H. M. 1961. New species and revisions in the order Tuberales. Mycologia 53:215-220.

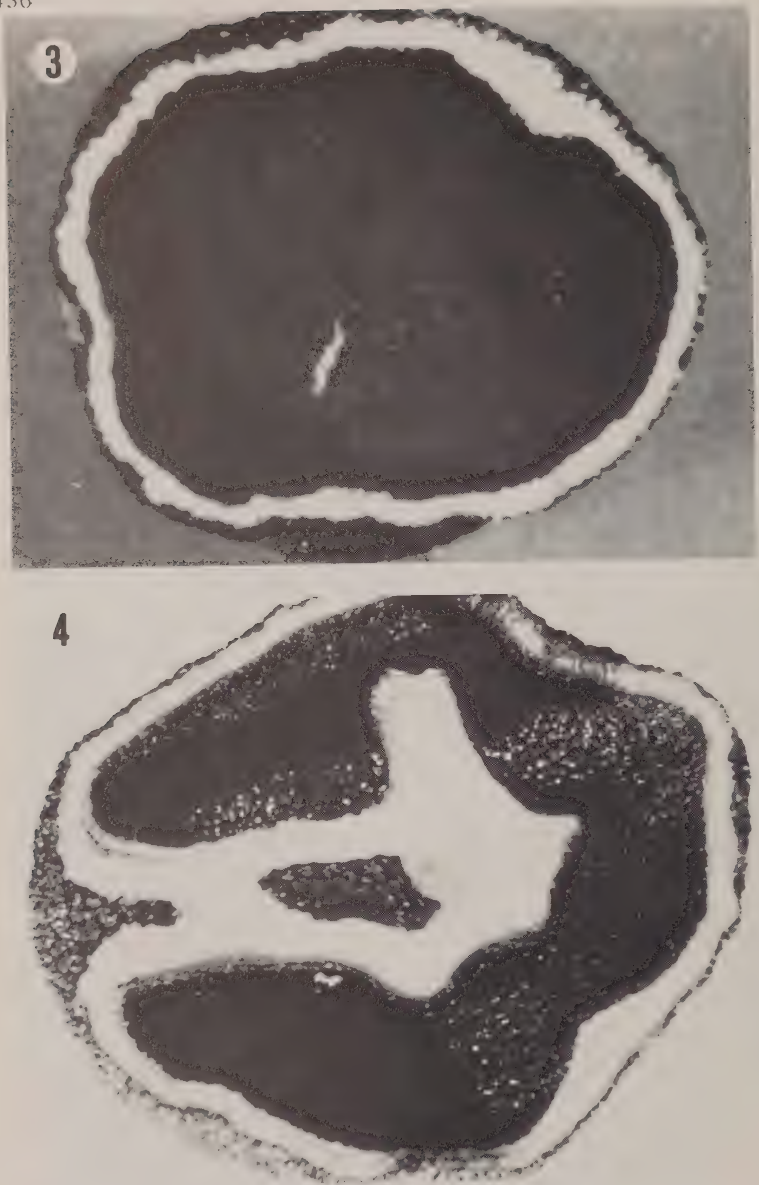
4. Korf, R. P. 1973. Discomycetes and Tuberales. *In* G. C. Ainsworth, F. K. Sparrow, and A. S. Sussman (eds.), The Fungi IVA:249-319.

5. Ridgway, R. 1912. Color standards and color nomenclature. Washington, D. C.

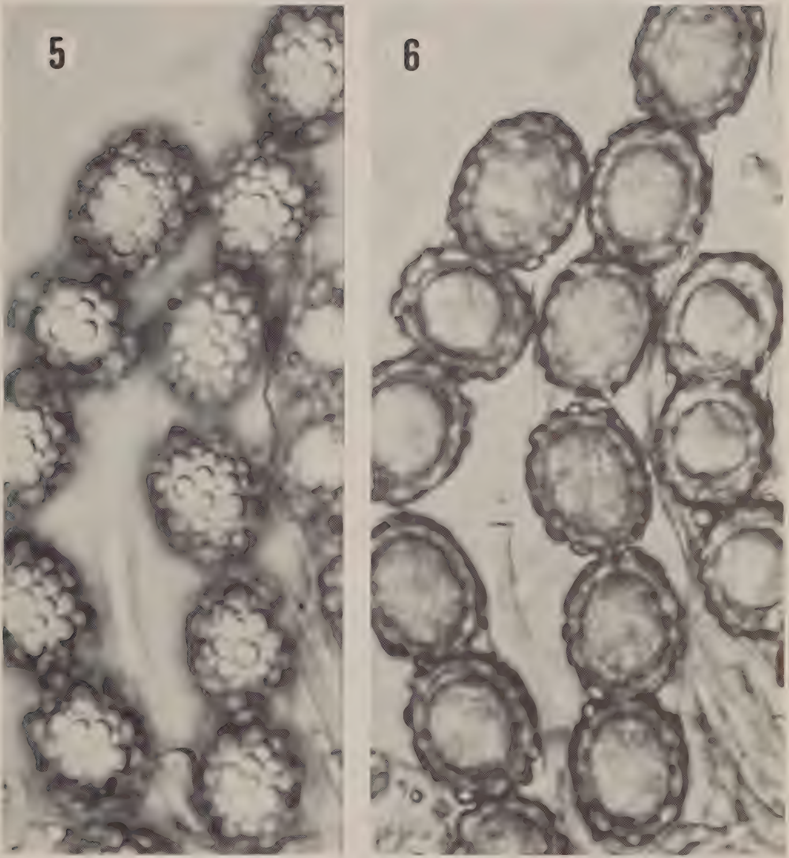
6. Trappe, J. M. 1975. Generic synonyms in the Tuberales. Mycotaxon 2:109-122.



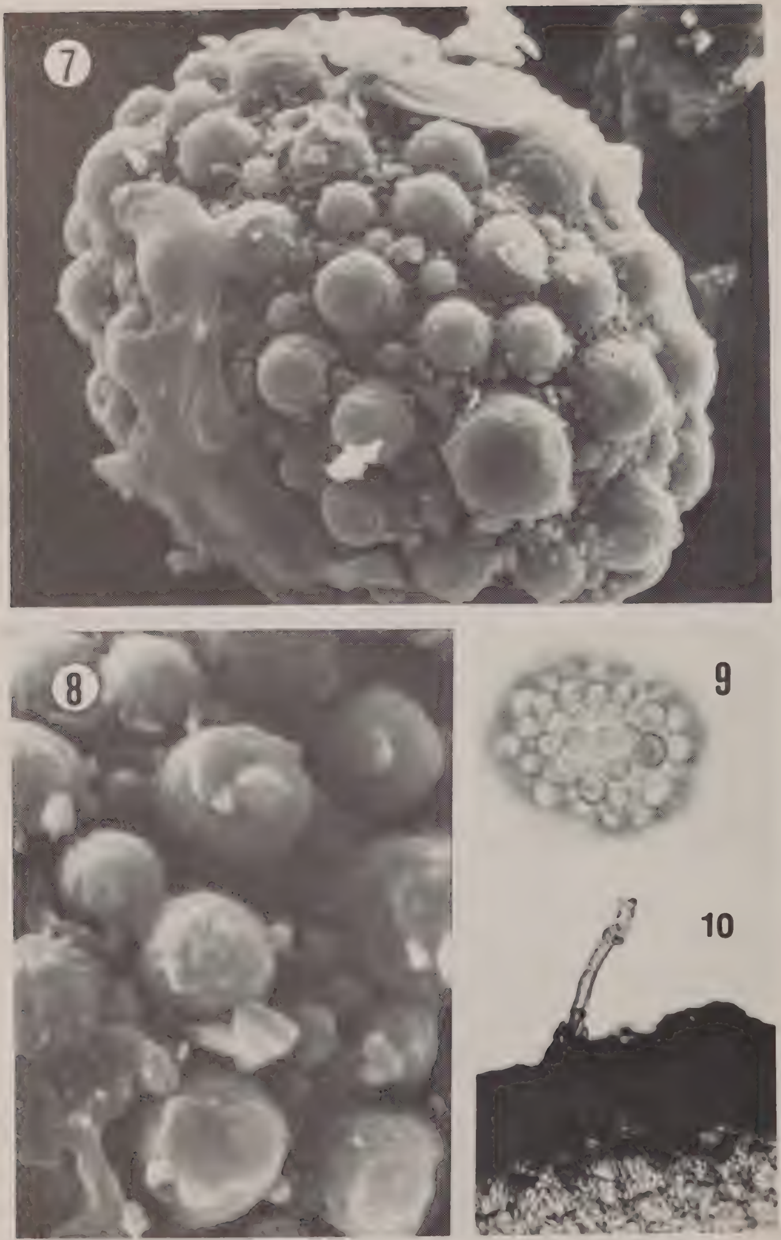
FIGS. 1-2. *Genea anthracina*. 1. Apical view of ascocarp showing circular opening. 2. Basal view of ascocarp showing mycelial tuft. Both X13.



FIGS. 3-4. *Genea anthracina*. 3. Cross section of an ascocarp with an unchambered cavity. 4. Cross section of an ascocarp with a chambered cavity. Both X10.



FIGS. 5-6. *Genea anthracina*. Optical cross-section of spores in Melzer's reagent. 6. Surface view of spores in Melzer's reagent. Both X750.



FIGS. 7-10. *Genea anthracina*. 7. Ascospore surface morphology X3350. 8,9. Ascospore surface showing papillae with accessory minute minor papillae. Fig. 8, Scanning electron micrograph X7000. Fig. 9, Interference phase contrast X1000. 10. Epithecium with a septate hair X500.

MYCOTAXON

Vol. IX, No. 2, pp. 459-463 July-September 1979

NOTES ON MYCOLOGICAL HISTORY.

I. M.A. CURTIS VS. A NATIONAL HERBARIUM.

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For the first years of the National Herbarium (under the aegis of the Smithsonian Institution from its inception) the botanical specimens were "arranged" by Torrey and Gray, and resided at Columbia College (now Columbia University) in New York. After a few years, Torrey's age and his other pressing duties necessitated the return of the specimens to Washington, but Dr. Henry (Secretary of the Smithsonian) pushed for some other arrangement as the costs of maintaining the herbarium mounted (cf. Annual Reports of the Smithsonian for 1865, 1866, 1867). A fire in 1865, which destroyed some collections, gave further impetus to some change (the Institution library was joined to others to form the Library of Congress in 1866), and in 1868, the botanical collections were shifted to the Agriculture Department. English-born Charles Christopher Parry remained in charge of the collections throughout the shift.

In 1866, just in the midst of the controversy as to the fate of the Smithsonian collections, Isaac Newton, the (first) Commissioner of the Department of Agriculture, issued a circular apparently sent to individual botanists and other interested parties, announcing that the Department had received a "large collection of plants gathered in different states," and requesting specimens from other locations so as to build a more representative herbarium. The circular listed the plants in the newly acquired collection, including 72 fungi. Although not mentioned in the circular, the author of the "catalog" was F[erdie] Pech, who according to Farlow (Farlow & Trelease, 1886) was employed as botanist for the Department, and most of the collections originated in "Louisiana, Mo." The covering solicitation by Newton offered other donors an exchange of duplicates of many of the species on the list.

In those years, the Rev. Moses Ashley Curtis (1808-1872) was surely the most influential worker in the fungi, acting as a collector himself, but even more as a conduit of specimens sent him by other collectors, passed on by him to the

Rev. Miles Joseph Berkeley (1803-1889) in England. Pech's list, which may have been sent to Curtis directly, and in which Pech's name was given as sole authority for 33 fungus names, angered Curtis, who stormed in a letter to Berkeley:

> [25.iv.1867]
>
> "A German charlatan has imposed himself upon the Agricultural department at Washington; started an Herbarium in connexion with it, published a catalog of species on hand, inviting exhanges, &tc. His list of 71 Fungi was such a curious melange, that I was curious to see some of the specimens. Thirty species were given as new on the authority of one Pech. I succeeded in getting fourteen species [of which six are listed as synonymous with other names he knows]. The fellow does not seem to have even ever seen any later author than Persoon, & never to have heard of Schweinitz. His thirty new species are all probably old & common things, published 40 or 50 years ago. I have written to the Chief of Department exposing his ignorance and impudent presumptions. How it will end remains to be seen. What ought to be done with such imposters?"

But more than this, the idea of a national herbarium under the Agriculture Department was obviously involved in Curtis's thoughts, and he combined his rancor over Pech's list and establishment of such a herbarium in a protest document[1], as follows.

> "We have several protests to make upon this thing. We protest against the Ag. Dept. created & keeping in charge a National Herbarium. It is not worth the trouble nor the expense, while we have so many Scientific Associations & cabinets in which collections are more appropriately gathered & better preserved. Such collections in connection of our Dept. Agric. are utterly worthless. The Commissioner is not likely to be a Botanist, & so will be easily imposed upon by any passing pretender who knows a little more of Botany than himself, as the present incumbent has already been; a case which [hardly] will occur in such an Institution as the Smithsonian, our Academies of Nat. Sciences, or our Colleges. - The whole thing is a work of supererogation, useless, unnecessary, expensive, opening the door to an extensive . . . jobbing.

---

[1] A handwritten draft is in the Southern Historical Collection, University of North Carolina. I do not know if the document was eventually signed by others to conform to the plural of the document itself, or whether it was actually sent to authorities in the Agricultural Department.

"We protest also against an entire stranger to bot. literature being put in charge of a Nat. Herbarium, & allowed to put forth a Catalogue of species, in which he ignores the existence & the publication of Botanical writers for the past 25 or 30 years; a Catalogue which can only excite indignation among American adepts, & astonishment at our ignorance, or presumptions, or gullibility, abroad.

"We protest against the introduction into our nomenclat, such barb. words as 'quisqualis' & 'phloxii,' awk. neither Greek, Latin, French or German or English.

"We protest against the presumption by which a man ventures to publish as new what has been well known to science for scores of years; who does not know such standard Authors as Fries, Klotzsch, Link, Nees, Dezmas[ieres], Montagne, Berkeley, or others in Europe, or Muhlenberg, Schweinitz, Curtis & Ravenel, of the U.S. who have published thousands of species of Fungi of which the author of this Catalogue does not seem ever to have heard. - What would be said of an American who shd. make a collection of a few 100 of plants of Europe, & publish a list of them in Paris, Vienna, or Berlin, publishing as new species every Moss, Lichen, or Fungus, that is to be found in the writings of Linnaeus, unmindful or ignorant of . . . the succeeding Writers upon those Orders of Vegetation?

"We protest against the whole scheme as useless and expensive; & we protest most indignantly against . . . its first development as being calculated to bring dishonor on government and country.

"In the most numerous, tho' most obscure, Order of Plants, we have but a beggerly list of species, 71 in all. This number can be gathered in three hours in any acre of woods in the country. Nearly half of these the compiler of the Catalogue has given as new species, while we venture to say that not one of them is new, & many of them, as we can plainly see from the names, were described & published by Schweinitz as far back as 1820 in his "Synopsis Fungorum Carolina Superioris," & again in his "Synopsis Fungorum in America Boreale" wh: contains 3098 species.

"We protest against obsolete systems, exploded genera (such as Merisma & Fuligo, & anomalous combinations of Orders (such as Trichogast & Myxogast under Lycopodiaceae) being reproduced.

"P.S. Perhaps it may be well for me to state, in evidence of my qualifications to pass judgement on Mr. Pech, that the U.S. Government & the Smithsonian

> Institution have repeatedly entrusted to me collections of Fungi for determination. See in Wilkes' South Sea Expedition, & also Com. Rodgers Pacific Expedition, American Journal of Arts & Sciences, Journal of the Linnaean Society (London) &tc, &tc.
>
> "I have the largest collection of Fungi on this continent, & number among my correspondents the ablest Mycologists of Europe.
>
> "It is in the Love of Science, of Science in the U. States, & in respect for those honored names who have gone before us, (wholy ignored by a foreign pretender,) that I make this private exposure of humbuggery & impudent pretension. I have not yet decided whether a public exposure may not be useful & proper. Others are talking about it."

It must be assumed that Curtis directed his distaste specifically toward Pech because of Pech's apparent authority, for the circular was not signed. Farlow & Trelease (1886) mentioned the list in disparaging terms, and stated that the circular may well have been suppressed "in consequence of the very numerous errors it contains." I can find no other references to Pech.[2]

Not the least of the mysteries surrounding the list is its date. Although undated on its face (only "186 ."), Farlow's copy was dated in writing 1 Nov. 1866 (cf. Farlow & Trelease, 1886). Newton, the Commissioner, closed his covering letter to the list with these words: "By attending to this request [for specimens from outside donors] the Agricultural Department will, in a few years, have in its iblic Museum samples of reference from the mineral, vegeable, and animal kingdoms wherewith to promote scientific id useful knowledge and advance the agricultural interests f our common country." The Department chief certainly was ointing policy toward the enlargement of the Department's ollection in direct competition with the Smithsonian istitution, whose collections were far more numerous, more epresentative, and better arranged. Why this was the case do not know, but Curtis was in correspondence with Dr. enry of the Smithsonian, who was already urging Congress id the Institution to provide more funds for the collecion's curation and/or to relieve the Institution of their are (and cost). Moreover, Curtis wished the Smithsonian istitution to publish the fruits of his (and Berkeley's) abors, so it would have been politic to support Dr. Henry id his position in this regard.

For a time I confused Pech with Charles Horton Peck ecause of Curtis's handwriting. Curtis apparently never hought badly of Peck, albeit with some impatience, but my istake led to some hours of fruitless investigation.

Curtis's documents were not characteristic of his demeanor, at least in writing, over the years of his botanical collecting. Although he was given to periods of impatience both toward his mentor, Berkeley, and toward his suppliers, he never resorted to the strong tactics and words used over the above issues. It might be remembered, however, that all this transpired not long after the Civil War, through which Curtis had suffered significant discomfort, and in a period when Curtis's health was oscillatory. Very shortly afterward, he began to complain of "an affection of the head" which left him drained, awkward of balance, and hardly able to think and write about botany. All this may help to account for his overt hostility in these matters.

Last, Pech's new names, without circumscriptions or direct references, must be considered invalid, albeit intriguing. They may return to the obscurity they have enjoyed all these years.

Literature Cited

Farlow, W.G. & W. Trelease. A list of works on North American Fungi. Harvard Univ. Libr. Bibliogr. Contrib. 25: 34 p. 1887.

[Pech, F.] Catalogue of the United States plants in the Department of Agriculture. U.S. Dept. Agric. unnumbered circular. 27 p. "1866."

Author's note. The extensive correspondence from Curtis to Berkeley is in the library of the British Museum of Natural History: the letters from Berkeley to Curtis are in the Southern Historical Collection, University of North Carolina, Chapel Hill. The staffs of these institutions are thanked for their cooperation. A more comprehensive paper on this correspondence is in preparation.

MYCOTAXON

Vol. IX, No. 2, pp. 464-468 July-September 1979

A NEW COMBINATION IN THE GENUS FLAGELLOSCYPHA AND A CONTRIBUTION TO THE IDENTITY OF CYPHELLA PECKII

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Summary: In the genus *Flagelloscypha*, a new combination is proposed: *Flagelloscypha parasitica* (Berk. & Br.) Agerer. *Cyphella peckii* Sacc. is listed as a synonym of *Flagelloscypha faginea* (Lib.) W.B. Cooke.

During the last three years, further studies were made in the genus *Flagelloscypha* Donk emend. Agerer and in other cyphellaceous fungi by the author. Among other fungi studied by lightmicroscopy was the type of *Lachnella parasitica* (Berk. & Br.) W.B. Cooke from the genus *Lachnella* Fr.ss. W.B.Cooke (1961). It became apparent that this species is a typical *Flagelloscypha* - because of the typical surface hairs and spores (Agerer 1975) - but not identical to any known species of this genus. Therefore a new combination is proposed.

In 1975 the relation of *Cyphella peckii* Sacc. to the species' of *Flagelloscypha* was shown (Agerer 1975). Being aware of some differences between this species and *F. kavinae* (Pilát) W.B. Cooke, I have temporarily placed it near this species. It is now obvious, that *Cyphella peckii* is conspecific with *F. faginea*.

FLAGELLOSCYPHA PARASITICA (Berk. & Br.) Agerer comb.nov.

Basionym: *Cyphella parasitica* Berk. & Br., J. Linn. Soc. Lond. Bot. 14: 74. 1875.

≡ *Chaetocypha parasitica* (Berk. & Br.) O. K., Rev. Gen. 2: 847. 1891.

≡ *Lachnella parasitica* (Berk. & Br.) W.B. Cooke, Beih. Syd. Ann. Mycol. 4: 75. 1961.

Holotypus: Ceylon, Peradeniya, Dec. 1868 (K).

Figure 1

Fruitbody shallowly cupulate with appressed to patent hairs, white, hymenium slightly yellowish, up to 0.6 mm in diameter and 0.1 mm high, fruitbodies in groups on stromata of a Pyrenomycete. Surface hairs incrusted with acicular to rhombic crystals; crystals up to 4 µm long, in 10 % KOH slowly soluble, readily soluble in hydrochloric acid, acicular structures on the hyphal walls remaining; surface hairs 2 - 3 (- 3.5) µm in diameter, basally clamped, walls up to almost 1 µm thick, in 10 % KOH scarcely swelling, not distorting, only slightly dextrinoid, secondarily septate; whiplike ends up to 16 µm long, surface hairs basally thin-walled. Hyphae between basidia and surface hairs not distorted. Hyphae of the trama a little agglutinated, with clamps, 1 - 3 µm in diameter. Basidia 20 - 25 (- 28) x 6.5 - 7.5 µm (marginal

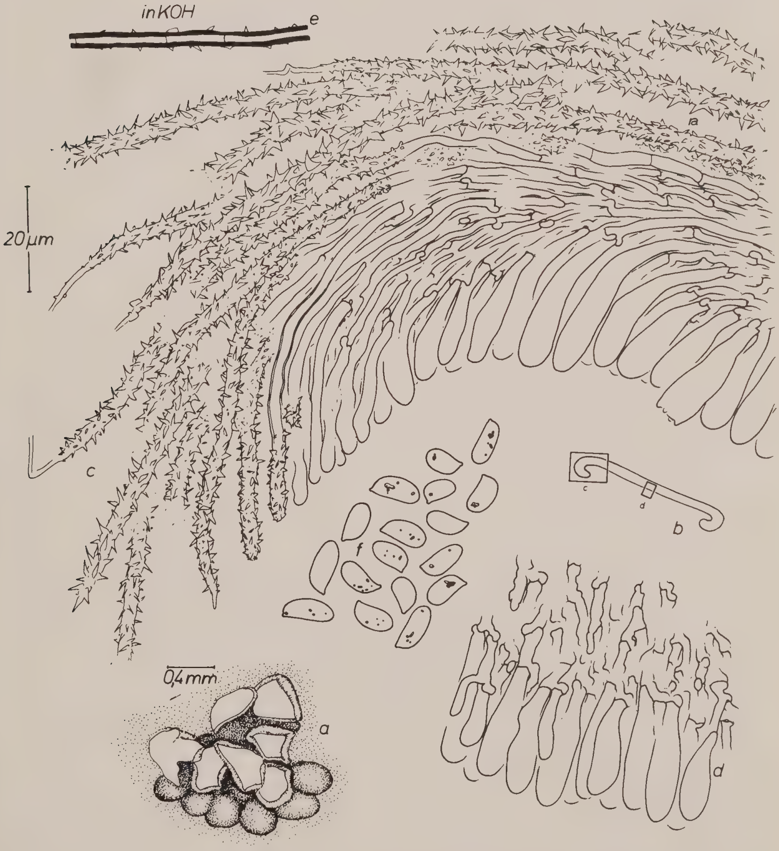

Fig. 1: *Flagelloscypha parasitica* : a) fruitbodies, habit, - b) section through a fruitbody, survey, - c) section through a fruitbody, detail of the edge, - d) section through a fruitbody, detail of the bottom, - e) surface hair in phase-contrast after submerging in 10 % KOH, - f) spores. - Holotypus (K).

up to 40 µm), slightly suburniform, 4-sterigmate, basally clamped. Spores hyaline, smooth, thin-walled, asymmetrically-elliptic to cylindric to almost allantoid, (6.5 -) 7 - 8.5 (-9.5) x 3.5 - 4.5 µm, averaging 7.5 µm long; sporefactor ca. 1.9; neither amyloid nor dextrinoid.

Discussion: The shape of the fruitbodies of *F. parasitica* resembles that of *F. virginea* Massee in W.B. Cooke (Agerer 1975: 250), but these species' are clearly distinguishable. *F. virginea* possesses basally thick-walled surface hairs, smaller and asymmetrically-elliptic to naviculate spores which are (5.5 -) 6 - 8 (-9)x 2 - 3 (-3.5) µm.

F. flagellata (Petch) W.B. Cooke has similar spores, but this species produces long, bell-shaped fruitbodies.

Another species formerly placed in the genus *Flagelloscypha* Donk ss. W.B. Cooke (1961), "*F. applanata* (Talbot) W.B. Cooke", is now the type species of the tremellaceous genus *Heteroscypha* (Agerer & Oberwinkler 1979). Its spores are similar to those of *F. parasitica*. However, they germinate by repetition and the basidia are partly longitudinally septate.

Of these species only *F. parasitica* grows parasitically on stromata of Pyrenomycetes.

FLAGELLOSCYPHA FAGINEA (Lib.) W.B. Cooke, Beih. Sydowia
Ann. Mycol. 4: 60. 1961.

Holotypus: Belgium, Pl. Arduenae, - Fasc. IV, 331, 1837, in fagetis ad folia dejecta, autumno (K, isotypi: BPI, HBG, PR, S).

Fig.: Agerer (1975) - Sydowia Ann. Mycol. 27: 215.

≡ *Calyptella faginea* (Lib.) Quél., Ench. fung. 216. 1886.
≡ *Chaetocypha faginea* (Lib.) O. K., Rev. Gen. 2: 847.1891.
≡ *Cyphella faginea* Lib., Cr. Arden.: 331. 1837.
= *Cyphella peckii* Sacc., Syll. Fung. 6: 684. 1888, ≡ *Cyphella candida* Peck, N. Y. State Mus. 27: 99. 1875 (f. Burt 1914), (non *Cyphella candida* Jungh., in: Praemissa in Floram cryptogamicam Javae insulae, Fasc. I, Batavia). Holotypus: USA, New York, Forestburgh, Peck (NYS); Fig.: Agerer (1975) - Sydowia Ann. Mycol. 27: 225.

Figure 2

A detailed description of *Flagelloscypha faginea* was given in an earlier publication (Agerer 1975: 214).

The basis for declaring *Cyphella peckii* a synonym of *F. faginea* is the result of studies of a specimen collected on ferns in the Bavarian Alps. The fungus (characterized and drawn in fig. 2) can be placed between typical *F. faginea* and *C. peckii*. The crystals of the surface hairs of this specimen are acicular as in typical *F. faginea* and in *C. peckii*, however, have an intermediary size. They are a little smaller than those of typical *F. faginea* and a little bigger than those of *C. peckii*. The structures between the surface hairs and the basidia are distorted in typical *F. faginea* as well as in the Bavarian specimen and in *C. peckii*. However, in *C. peckii* this distortion is not so apparent. The spores in all specimens discussed are similarly shaped, but those of *C. peckii* are somewhat smaller. In *C. peckii* as in *F. faginea* the surface hairs are flagellate and their bases are thin-walled. The basidia and the fruitbodies are alike in shape.

The above mentioned specimen from the Bavarian Alps seems to link the numerous well known specimens of typical *F.*

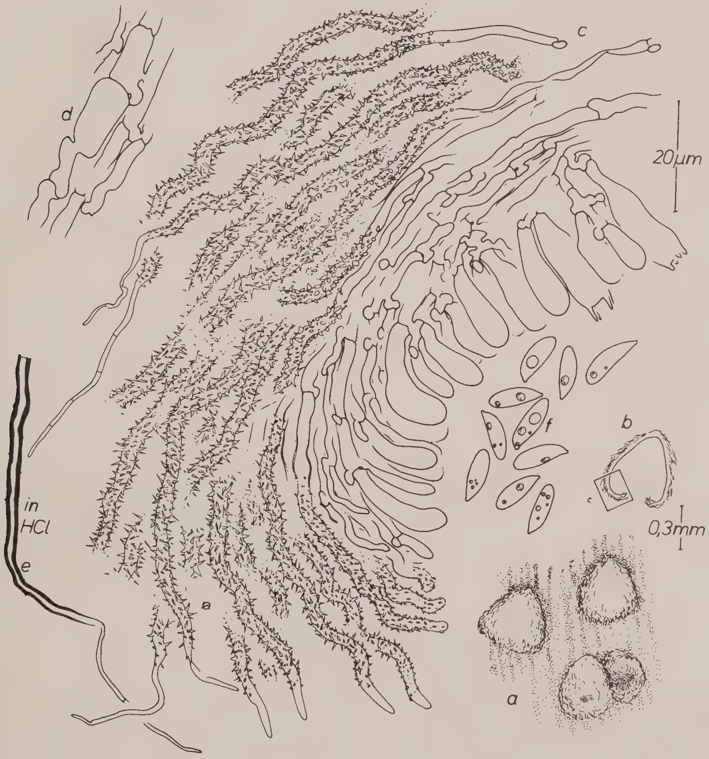

Fig. 2: *Flagelloscypha faginea* : a) fruitbodies, habit, - b) section through a fruitbody, survey, - c) section through a fruitbody, detail, - d) hyphae of the trama from the base of a fruitbody, - e) surface hair in phase-contrast after submerging in hydrochloric acid, - f) spores. - (Herb. R. Agerer 7911, Deutschland, Bayern, Garmisch-Partenkirchen bis zur Partnachklamm, an Athyrium filix-femina, Agerer, 16.10.1977).

faginea and the type-specimen of *C. peckii.*

The Bavarian specimen as well as the type-specimen of *C. peckii* were found on ferns. Cooke (1961) mentions in his list of habitats for *F. faginea* the ferns *Blechnum spicant* and *Pteridium aquilinum.* In the meantime, among species not known to grow on ferns, some new specimens were found which fruited on ferns, e.g. *F. punctiformis* (Fr.) Agerer. Therefore it would seem that growth on ferns is not necessarily an important characteristic.

Cooke (1961) placed *C. peckii* in synonymy with *Lachnella filicina* (Karst.) W.B. Cooke. However, *L. filicina* possesses surface hairs with rounded apices; the type-specimen of *C. peckii* has flagellate apices like the species of *Flagelloscypha.*

As *Cyphella peckii* (1888) is a newer synonym of *C. faginea* (1837), the name *F. faginea* is valid.

In 1838 Junghuhn (l.c.) described *Cyphella candida* Jungh. as "membranacea, candida, subcernua ..." . According to this description, this 'Cyphellaceae' is not identical to the fungus which Peck (l.c.) published under the name *Cyphella candida* Peck. Therefore, Saccardo (1888 l.c.) chose, instead of Peck's invalid name, the new name *Cyphella peckii* Sacc.

Acknowledgements: I am much obliged to the directors of the herbaria Royal Botanical Gardens, Kew, Surrey (K) and New York State Museum, Albany (NYS) for loaning the type-material.

Literature

Agerer, R. (1975) - Flagelloscypha - Studien an cyphelloiden Basidiomyceten. Sydowia Ann. Mycol. 27: 131 - 265.
 - & F. Oberwinkler (1979) - Cyphelloide Tremellaceae (In print).
Burt, E.A. (1914) - Thelephoraceae of North America III. Ann. Miss. Bot. Gard. 1: 357 - 382.
Cooke, W.B. (1961) - The Cyphellaceous Fungi. A Study in the Poroteleaceae. Beih. Sydowia Ann. Mycol. 4: 1 - 144.

MYCOTAXON

Vol. IX, No. 2, pp. 469-481 July-September 1979

NOTES ON HYPHOMYCETES. XXXII.
FIVE NEW AQUATIC SPECIES

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ABSTRACT

Five new aquatic hyphomycetes, *Lemonniera alabamensis, Mycocentrospora varians, Pseudoanguillospora gracilis, Pyramidospora stellata* and *Tripospermum prolongatum* are described and illustrated from collections made in an Alabama stream.

INTRODUCTION

In a preceding publication in this series (Sinclair and Morgan-Jones, 1979) a new, monotypic genus of aquatic hyphomycetes, *Obstipispora* Sinclair and Morgan-Jones, was described from collections made in a stream traversing Chewacla State Park in east Alabama. Further studies of the lotic mycoflora at this locality have yielded records of forty two previously named species in addition to *Obstispora chewaclensis*, five taxa which we believe to be undescribed, and twenty four conidium types to which no name can at present be attached (Sinclair, 1979). The new taxa are assignable to known genera and are described and illustrated herein.

TAXONOMIC PART

Lemonniera alabamensis sp. nov. (Fig. 1).

Fungus aquaticus. Mycelium plerumque in substrato immersum, ex hyphis ramosis, septatis, hyalinis, laevibus 2 - 3.5μ crassis compositum. Conidiophora macronemata, mononemata, hyalina, cylindrica, erecta, recta vel flexuosa, ramosa, multiseptata, usque ad 250μ longa, 3 - 4μ crassa, ad apices 1 vel 3 phialides gerentia. Cellae conidiogenae (monophialides) terminales, discretae, laeves, clavatae. Conidia acrogena, solitaria, hyalina, laevia, cum parte centrali globosa, 5μ diam. cum phialide connexa, cum uno

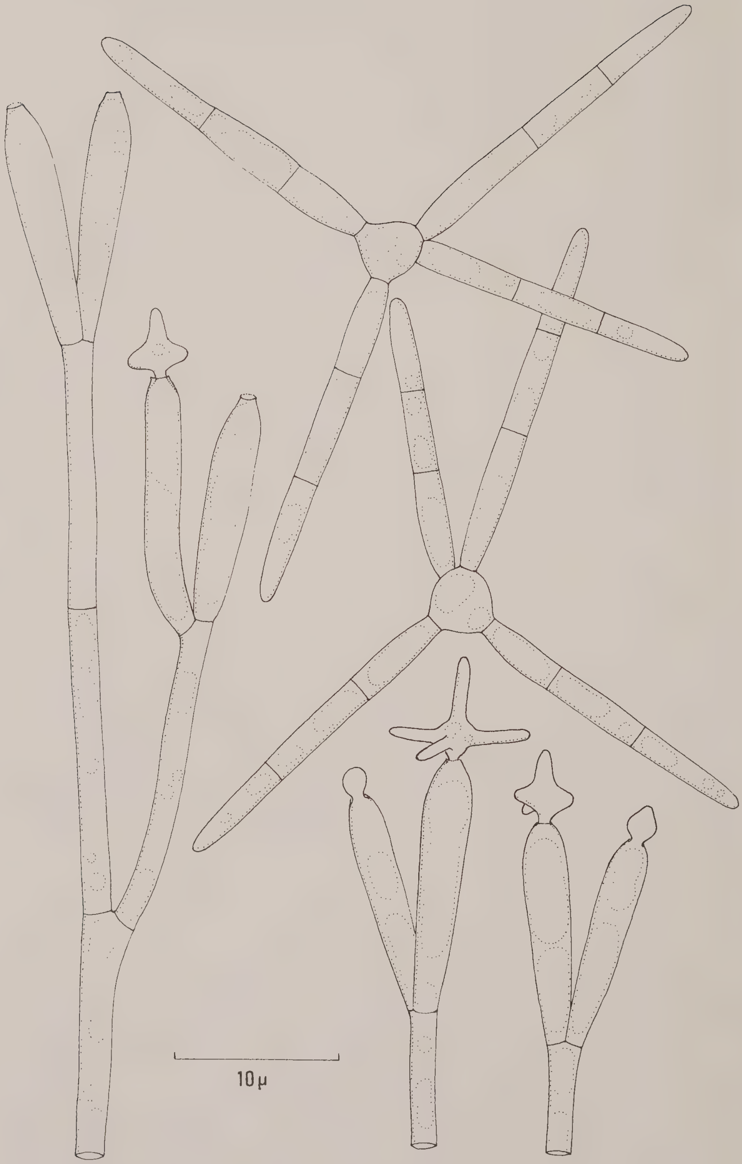

FIGURE 1. *Lemonniera alabamensis*

axe et 4 vel 5 ramis, divergentibus. Rami 30 - 35 X 2 - 3μ, 2 septati.

In corticis emortuis Betulae nigrae in flumine, Chewacla State Park, Lee County, Alabama, August 15, 1978, R.C. Sinclair, AUA, holotypus.

Aquatic fungus. Mycelium mostly immersed in the substratum, composed of branched, septate, hyaline, smooth, 2 - 3.5μ wide hyphae. Conidiophores macronematous, mononematous, hyaline, cylindrical, erect, straight or flexuous, branched, multiseptate, up to 250μ long, 3 - 4μ wide, bearing from one to three phialides at the apex of the main axis and of the branches. Conidiogenous cells monophialidic, terminal, discrete, smooth, clavate. Conidium initials at first spherical, then becoming tetrahedral with arm development. Conidia acrogenous, solitary, hyaline, smooth, with a central globose or subglobose body 5μ in diameter and 4, or rarely five radiating arms; arms equal in length or variable, 2-septate, obtuse at the apex, very slightly constricted at point of attachment to central body, 30 - 35 X 2 - 3μ.

On bark of *Betula nigra* L.; North America.

Collection examined: on *B. nigra* submerged in a stream, Chewacla State Park, Lee County, Alabama, August 15, 1978, R.C. Sinclair, AUA, type.

Several single spore cultures of this organism were obtained on 2% malt agar. Isolates incubated at 15°C grew slowly, attaining an average diameter of 3.5 - 4cm. after 14 days. The fungus forms compact, lanose to felted, dark olivaceous green colonies. Reverse of colonies olivaceous black. No sporulation occurred on agar plates. Strips of 14 day old cultures when submerged in actively aerated distilled water sporulated abundantly after 48 hours.

Descals, Webster and Dyko (1977) in the first of a series of taxonomic revisions of aquatic hyphomycete genera considered *Lemonniera* and accepted six species, one of which was described as new. The taxa are defined on conidium characteristics. Two species are distinguished from the others on the basis of the presence of a distinct central body. These are *L. centrosphaera* Marvanová and *L. pseudofloscula* Dyko. To these may not be added *L. alabamensis*. This taxon differs from *L. centrosphaera* in having a smaller central body (5μ as opposed to 6 - 9μ) and much shorter arms (30 - 35μ as opposed to 70 - 102μ). Marvanová (1968) reported conidium arm length of up to 142μ for *L. centrosphaera* but those reported by Miura (1971) and Descals, Webster and Dyko (1977) were shorter. In common with *L. centrosphaera* the arms in *L. alabamensis* lack a basal isthmus and by this characteristic they are easily distinguishable from *L. pseudofloscula*. *L.*

pseudofloscula also has longer arms than *L. alabamensis* 30 - 70μ) and are distinctly tapered.

Mycocentrospora varians sp. nov. (Fig. 2).

Fungus aquaticus. Mycelium plerumque in substrato immersum, ex hyphis ramosis, septatis, hyalinis vel pallide brunneis, laevibus, 1 - 3μ crassis compositum. Conidiophora semimacronemata vel macronemata, mononemata, ex hyphis repentibus oriunda, simplicia, hyalina, laevia, recta vel flexuosa, cylindrica, interdum inflatis, usque ad 35μ longa, 1.5 - 2.5μ crassa. Cellae conidiogenae monoblaticae vel polyblasticae, in conidiophoris incorporatae, terminales. Conidia acrogena, solitaria, hyalina, laevia, septata, cylindrica, recta vel leviter curvata, 25 - 88 X 1 - 1.5μ.

In foliis putrescentibus in flumine, Chewacla State Park, Lee County, Alabama, April 12, 1978, R.C. Sinclair, AUA, holotypus.

Aquatic fungus. Mycelium mostly immersed in the substratum, composed of branched, septate, hyaline or pale olivaceous brown hyphae; hyaline hyphae 1 - 2μ wide, colored hyphae 2 - 3μ wide and tending to aggregate in strands. Conidiophores semimacronematous or macronemetous, mononematous, formed laterally from repent hyphae, simple, hyaline, smooth, straight or flexuous, cylindrical but sometimes in part inflated, 9 - 35 X 1.5 - 2.5μ. Conidiogenous cells monoblastic or polyblastic, integrated, terminal. Conidia acrogenous, solitary, hyaline, smooth, 6 to 8-septate, cylindrical, straight or slightly curved, obtuse at the apex, truncate at the base.

On decaying leaves; North America.

Collection examined: on unidentified leaves submerged in a stream, Chewacla State Park, Lee County, Alabama, April 12, 1978, R.C. Sinclair, AUA, type.

Several single spore cultures of this organism were obtained on 2% malt agar. Isolates incubated at 15° grew slowly, attaining an average diameter of 4 - 5cm. after 14 days. The fungus forms compact, lanose, dense, dark olivaceous gray colonies. Colonies are often somewhat zonate with rings of whitish mycelium alternating with darker areas. Reverse of colonies olivaceous black. There is sparse sporulation on agar plates. Strips of 14 day old cultures when submerged in actively aerated distilled water sporulated abundantly after 48 hours.

The conidia of *M. varians* are variable in several respects. There is considerable difference in conidium length even in single colonies. Short conidia are usually more or less straight, long ones are usually slightly

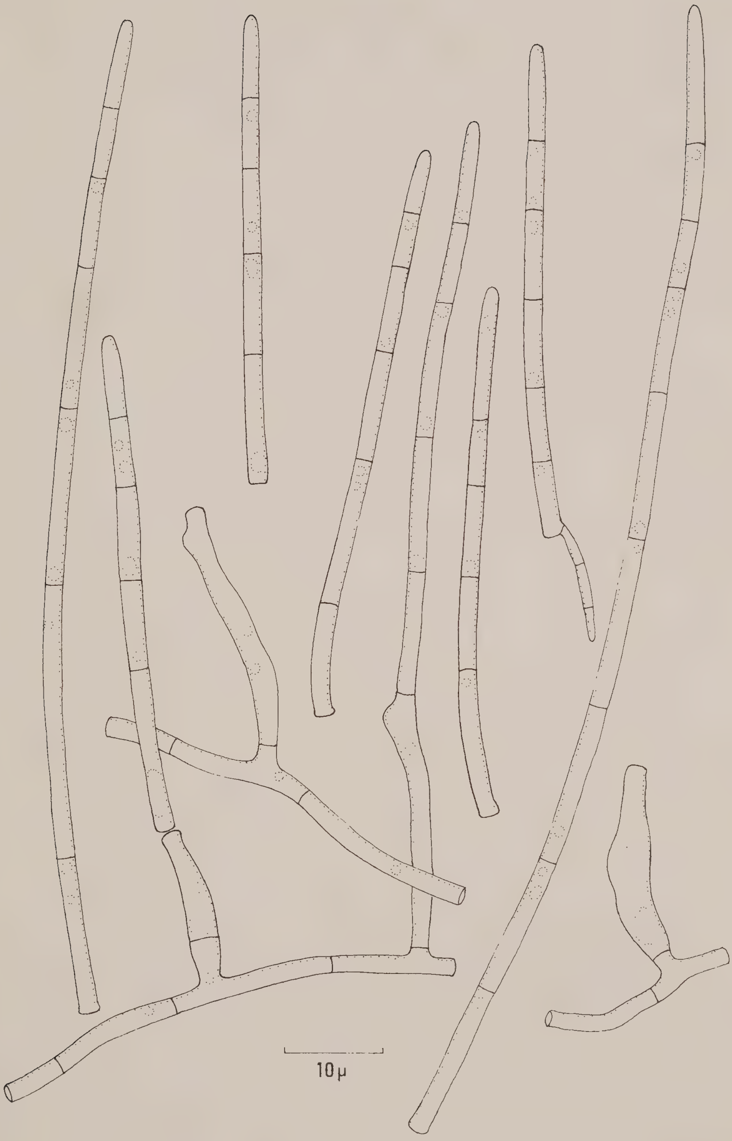

FIGURE 2. *Mycocentrospora varians*

curved. Distance between conidium septae is also variable. Septae in the upper half of the conidia are usually between 5 - 12μ apart, those in the basal half are up to 24μ apart. A basal appendage is not formed while the conidia remain attached to the conidiogenous cells. Occasionally, however, detached conidia bear an appendage-like extension laterally at the extreme base which is sometimes septate and may represent a very narrow germ tube.

Deighton (1971) pointed out that although the presence of a basal appendage has been considered a hallmark of the genus this was not a constant character and many specimens of the type species on natural substrata and in culture were without a conidial appendage. He described three others in which no basal appendage occurs.

The type species of *Mycocentrospora* Deighton, *M. acerina* (Hartig) Deighton, is a soil borne plant pathogen and the three species added to the genus by Deighton (1972) occur on leaves of plants in terrestrial circumstances. There are four species presently classified in the genus that have been described as aquatic in habit. They have in common with *M. acerina* the possession of polyblastic, sympodial conidiogenous cells as well as conidia of broadly similar morphology. *M. varians* resembles *M. angulata* (Petersen) Iqbal, *M. aquatica* (Iqbal) Iqbal and *M. filiformis* (Greathead)Iqbal in possessing long, narrow conidia but whereas the conidia of these species attenuate gradually towards the apex those of *M. varians* are cylindrical throughout their length. The conidia of *M. varians* are also generally much shorter than those of these species and a basal conidium appendage is absent. In the latter character *M. varians* is similar to *M. clavata* Iqbal but this species is distinct in having more or less clavate, broader conidia. *M. varians* somewhat resembles *M. acerina* and *M. clavata* in its conidiophore morphology particularly in being irregularly inflated. It does not, however, proliferate sympodially as abundantly as does *M. acerina*, this being another feature it has in common with *M. clavata*.

Pseudoanguillospora gracilis sp nov. (Fig. 3).

Fungus aquaticus. Mycelium plerumque in substrato immersum, ex hyphis ramosis, septatis, hyalinis vel pallide brunneis, laevibus, 2 - 3.5μ crassis compositum. Conidiophora micronemata, mononemata, hyalinis, filiformia, ramosa, recta vel flexuosa, leavia, septata, usque ad 230μ longa, 2 - 3μ crassa. Cellae conidiogenae monoblasticae vel polyblasticae, in conidiophoris incorporatae, terminales vel intercalares. Conidia solitaria, hyalina, laevia, septata, cylindrica, leviter curvata, 60 - 120 X 2μ.

In foliis putrescentibus Platani occidentalis in

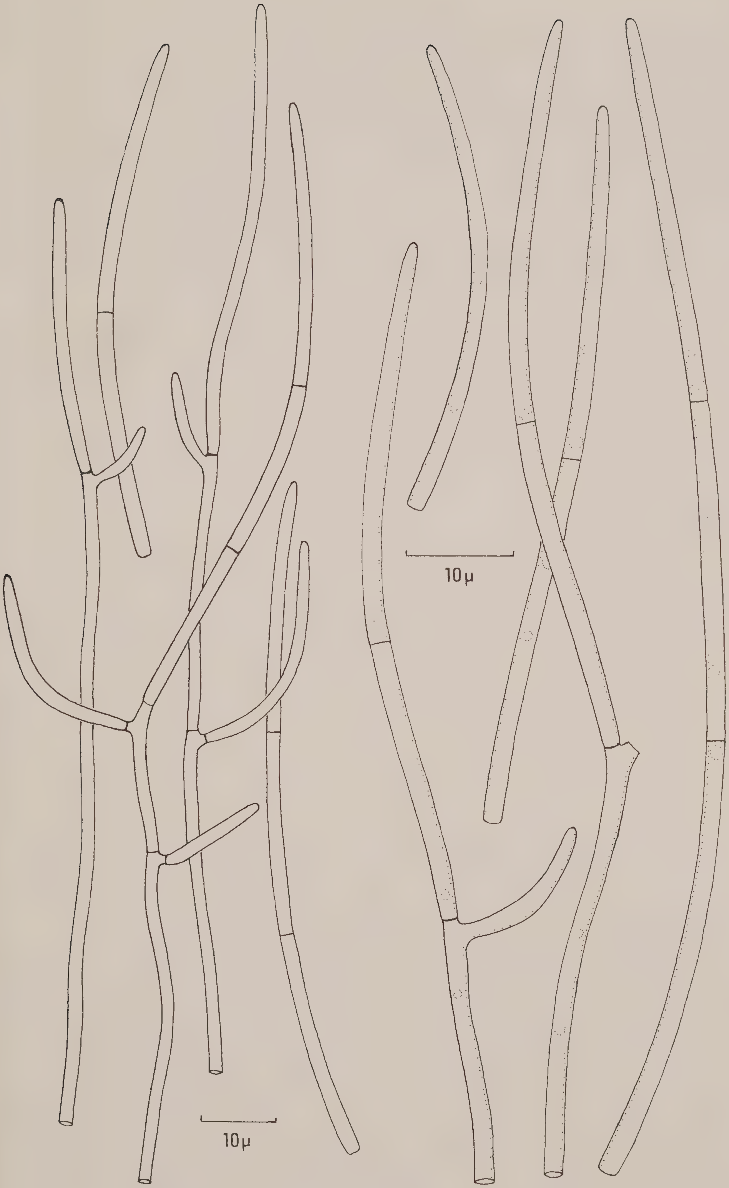

FIGURE 3. *Pseudoanguillospora gracilis*

flumine, Chewacla State Park, Lee County, Alabama, August 15, 1978, R.C. Sinclair, AUA, holotypus.

Aquatic fungus. Mycelium mostly immersed in the substratum, composed of branched, septate, hyaline to pale olivaceous brown, smooth, 2 - 3.5μ wide hyphae; pale brown hyphae sometimes aggregating in strands. Conidiophores micronematous, mononematous, hyaline, filiform, branched, straight or, more frequently, flexuous, smooth, septate, up to 230μ long, 2 - 3μ wide, producing conidia terminally or as lateral outgrowths originating at loci immediately below transverse septae. Conidiogenous cells monoblastic or polyblastic, integrated, terminal or intercalary. Conidia solitary, hyaline, smooth, 1 to 2-septate, cylindrical, slightly curved, 60 - 120 X 2μ

On decaying leaves of *Platanus occidentalis* L.; North America.

Collections examined: on *P. occidentalis,* Chewacla State Park, Lee County, Alabama, August 15, 1978, R.C. Sinclair, AUA, type; in foam (same locality and collector), October 16, 1978, AUA.

Several single spore cultures of this organism were obtained on 2% malt agar. Isolates incubated at 15° grew slowly, attaining an average diameter of 4 - 4.5cm. after 14 days. The fungus forms compact, lanose to somewhat felted, gray to olive gray colonies. Reverse of colonies dark olivaceous. There is sparse sporulation on agar plates. Strips of 14 day old cultures when submerged in actively aerated distilled water sporulated abundantly after 48 hours.

Iqbal (1974), when he established the genus *Pseudoanguillospora,* discussed its relationship to the similar genera *Mycocentrospora* and *Anguillospora.* He maintained that *Pseudoanguillospora* differed from *Mycocentrospora* by the absence of a basal conidium appendage and because the conidial scar left on the conidiophore is not conspicuous. The presence of a conidium appendage is not, however, as Deighton (1972) has pointed out, an invariable hallmark of *Mycocentrospora.* The presence of a basal appendage is not a fully satisfactory character by which to recognize even aquatic species of *Mycocentrospora* since the conidia of both *M. aquatica* and *M. varians* are predominantly non-appendaged. The matter of thickness of conidial scars can also be questioned. In an aquatic species such as *M. filiformis* it is difficult to discern any scar. If *Pseudoangillospora* is to be dinstinguished from *Mycocentrospora* the basis must be other characteristics of the conidiophores. Those of *Pseudoanguillospora* are micronematous, hypha-like, and there is no real sympodial proliferation. The terminal cell of the conidiophore forms but two conidia, one at the extreme apex and one in a subapical position immediately below the septum laid down to delimit the first conidium. In two species, *P. stricta* Iqbal, the type, and *P. gracilis* other conidia are formed retrogressively at intercalary loci immediately below conidiophore septae. As in the case of subapical conidia these arise as lateral outgrowths of the peripheral wall of the conidiophore. The conidiophores of *Mycocentrospora* are macronematous or, in the case of most of the aquatic species, semimacronematous, typically somewhat inflated, and exhibit sympodial proliferation where the youngest conidium at a given time is apical in position.

Pseudoanguillospora can be distinguished from *Anguillospora* in that the latter produces but one conidium per conidiophore, in a terminal position. While accepting *Pseudoanguillospora* as a useful entity it is recognized that this complex of genera is inevitably artificial and that each member is by no means easy to define without exceptions.

Pyramidospora stellata sp. nov. (Fig. 4).

Fungus aquaticus. Mycelium plerumque in substrato immersum, ex hyphis ramosis, septatis, hyalinis, laevibus, 1.5 - 2.5μ crassis compositum. Conidiophora micronemata, mononemata, hyalinis, filiformia, erecta, recta vel flexuosa, laevia, septata, usque ad 100μ longa, 1 - 2μ crassa. Cellae conidiogenae monoblasticae, in conidiophoris incorporatae, terminales. Conidia solitaria, hyalina, laevia, stellata; ex axi primario tricellularia, 15 - 25 X 3 - 5μ et 4 brachiis divergentibus composita; brachis usque ad 20μ longa, 4 - 5μ crassa ad basim, apicem versus 2 - 3μ crassa, 1 - 2-septata, attenuata, leviter constricta ad septa.

In foliis putrescentibus Aceris saccharini in flumine, Chewacla State Park, Lee County, Alabama, February 12, 1978, R.C. Sinclair, AUA, holotypus.

Aquatic fungus. Mycelium mostly immersed in the substratum, composed of branched, septate, hyaline, smooth, 1.5 - 2.5μ wide hyphae. Conidiophores micronematous, mononematous, hyaline, filiform, erect, straight or curved, smooth, septate, up to 100μ long, 1 - 2μ wide. Conidiogenous cells monoblastic, integrated, terminal. Conidia solitary, hyaline, smooth, star-shaped, with a three-celled primary axis, 15 - 25 X 3 - 4μ and four lateral divergent branches; branches up to 20μ long, 4 - 5μ wide at the base, 2 - 3μ wide at the apex, 1 to 2-septate, attenuated, somewhat constricted at the septa.

On decaying leaves of *Acer saccharinum* L., *Quercus alba* L., and *Salix* sp.; North America.

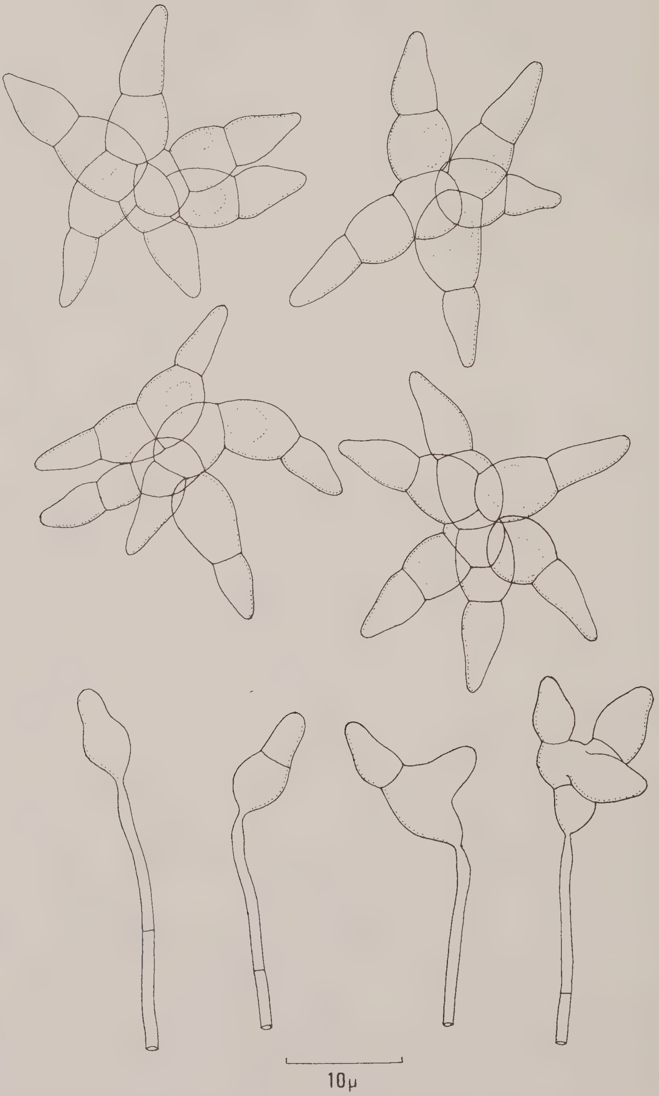

FIGURE 4. *Pyramidospora stellata*

Collections examined: on *A. saccharinum,* Chewacla State Park, Lee County, Alabama, February 12, 1978, R.C. Sinclair, AUA, holotype; on *Q. alba* (same locality, date and collector), AUA; on *Salix* sp. (same locality, date and collector), AUA; in foam (same locality and collector), June 12, 1978, AUA.

Six species of *Pyramidospora* Nilsson, other than *P. stellata,* are known. Five of these, *P. casuarinae* Nilsson, *P. constricta* Singh, *P. densa* Aladoadura, *P. fluminea* Miura and Kudo and *P. ramificata* Miura have been found at the same locality as the other fungi reported upon in this paper. These are the first records of the occurrence of these species in North America. *P. stellata* is readily distinguished from them and from the remaining species, *P. herculiformis* Singh, by the stellar configuration of its conidia.

Tripospermum prolongatum sp. nov. (Fig. 5).

Fungus aquaticus. Mycelium plerumque in substrato immersum, ex hyphis ramosis, septatis, hyalinis, laevibus, 2 - 3μ crassis compositum. Cellae conidiogenae monoblasticae, in hyphis incorporatae, intercalares. Conidia solitaria, hyalina, laevia, ramosa, ex dentibus hypharum vegetativarum oriunda; ex axe principalis flexa et 2 vel 3 ramis divergentibus composita; axe principalis 4-septatus, 39 - 44 X 1.5 - 3.5μ, rami 1 - 2-septati, 22 - 30 X 1.5 - 2μ.

In foliis putrescentibus in flumine, Chewacla State Park, Lee County, Alabama, April 12, 1978, R.C. Sinclair, AUA, holotypus.

Aquatic fungus. Mycelium mostly immersed in the substratum, composed of branched, septate, hyaline or pale olivaceous brown, smooth, 2 - 3μ wide hyphae. Conidiogenous cells monoblastic, integrated in hyphae, intercalary. Conidia solitary, hyaline, smooth, branched, produced as lateral outgrowths of the hyphae; consisting of a sharply bent principal axis and two or, predominantly, three divergent arms; principal axis 4-septate, 39 - 44 X 1.5 - 3.5μ, arms 1 - 2-septate, 22 - 30 X 1.5 - 2μ.

On decaying leaves; North America, (?) Europe.

Collections examined: on unidentified leaves submerged in a stream, Chewacla State Park, Lee County, Alabama, April 12, 1978, AUA, type; in foam (same locality and collector), August 15, 1978, AUA.

There is some evidence that this taxon has been encountered as conidia previously. Ingold, Dann and McDougal (1968) in their publication describing

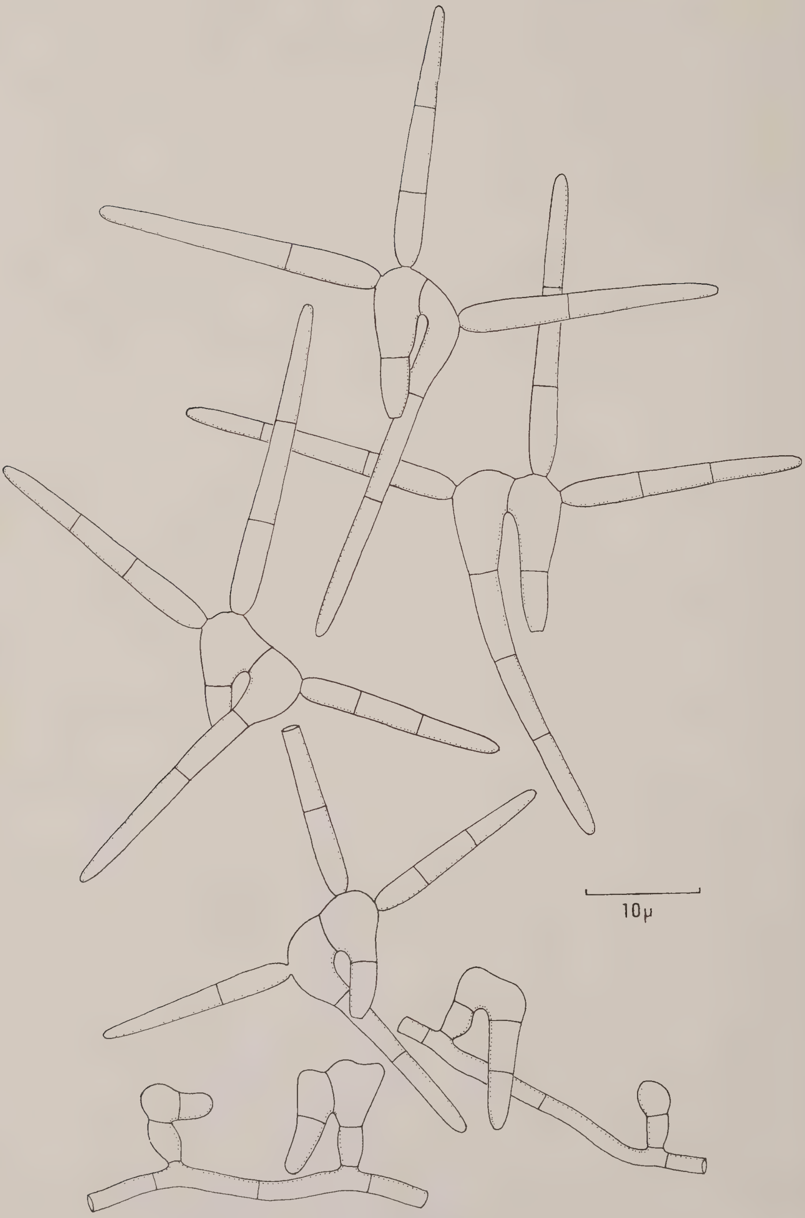

FIGURE 5. *Tripospermum prolongatum*

Tripospermum camelopardus illustrated conidia of an unnamed species. These seem very close to those of *T. prolongatum.*

Matsushima (1975) illustrated conidia of a similar fungus which he referred to as *Tripospermum* sp. MFC-1375 obtained on decaying leaves of *Pinus densiflora* in Japan. Several conidia identical to those of Matsushima's fungus have been found in foam during the present study. It seems likely that it represents a form of *T. myrti* (Lind) Hughes since that species is somewhat variable (Hughes, 1951).

ACKNOWLEDGMENT

We thank Dr. Richard T. Hanlin, University of Georgia, for reviewing this manuscript.

REFERENCES

DEIGHTON, F. C. 1971. Studies on *Cercospora* and allied genera. III. *Centrospora.* Mycol. Pap. 124:1 - 13. Commonwealth Mycological Institute.

DEIGHTON, F. C. 1972. *Mycocentrospora* a new name for *Centrospora.* Taxon 21:716.

DESCALS, E. , J. WEBSTER AND B. S. DYKO. 1977. Taxonomic studies on aquatic hyphomycetes. I. *Lemonniera* de Wildeman. Trans. Br. Mycol. Soc. 69:89 - 109.

HUGHES, S. J. 1951. Studies on micro-fungi. XII, *Triposporium, Tripospermum, Ceratosporella* and *Tetrasporium* (gen, nov,). Mycol. Pap. 47: 1 - 35, Commonwealth Mycological Institute.

INGOLD, C. T. , V. Dann and P. J. McDougall. 1968, *Tripospermum camelopardus* sp. nov. Trans. Br. mycol. Soc. 51: 51 - 56.

IQBAL, S. H. 1974. *Pseudoanguillospora,* a new genus of hyphomycetes, Biologia 20: 11 - 16.

MARVANOVA, L. 1968, *Lemonniera centrosphaera* sp. nov. Trans. Br. mycol. Soc. 51: 3 - 4.

MATSUSHIMA, T. 1975. Icones microfungorum a Matsushima lectorum, Kobe. Published by the author.

MIURA, K. 1971. Notes on filamentous fungi from Japan (5 & 6), J. Jap. Bot. 46: 193 - 198.

SINCLAIR, R. C. 1979, Studies on aquatic hyphomycetes. M.S. thesis, Auburn University.

SINCLAIR, R. C. and G. MORGAN-JONES. 1979, Notes on Hyphomycetes. XXIX. *Obstipospora chewaclensis.* gen. et sp. nov. Mycotaxon 8:

MYCOTAXON

Vol. IX, No. 2, pp. 482-492 July-September 1979

UREDINALES NOUVELLES DE l'HIMALAYA

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RESUME

Description des nouvelles espèces suivantes : *Melampsora ribis* sur *Ribes takara, Coleoporium nepalense* sur *Thunbergia cf. lutea, Puccinia pilearum* sur *Pilea scripta* et *P. umbrosa, Puc. mallae* sur *Clematis barbellata, Puc. manangensis* sur *Clematis cf. orientalis, Puc. commelinae* sur *Commelina benghalensis, Puc. heracleinepalensis* sur *Heracleum nepalense, P. annapurnae* sur *Polygonum polystachyum.*

Les échantillons décrits ci-dessous ont été récoltés dans diverses régions montagneuses du Népal central au cours de missions réalisées dans le cadre de la Recherche Coopérative sur Programme n° 253 du C.N.R.S., (Ecologie et Géologie de l'Himalaya). Les exsiccata sont déposés dans l'herbier cryptogamique du laboratoire de botanique de l'Université PAUL SABATIER (TLA), pour certaines espèces un isotype est également déposé dans l'herbier du «Département of medicinal plants» à Kathmandu (KTH).

Melampsora ribis n. sp.

Sur *Ribes takara* HORA, crête sud du Machapuchare 3200 m (massif de l'Annapurna) 24 . 10 . 76 .

Ce parasite se développait sur des feuilles également parasitées par *Cronartium ribicola.*

Les Téliosores, hypophylles, forment des croutes atteignant 0,5 mm de côté, d'abord jaune orangée claire, elles brunissent ensuite.

Les Téliospores sont diposées en couche sous-épidermique, elles mesurent de 30 à 53 µm de haut et 8 à 16 µm de diamètre, elles sont arrondies à la partie supérieure. La paroi mince, 1µm environ ne présente pas d'épaississement apical.

Cette espèce est très certainement le dérivé microcyclique d'une forme hétéroxène accomplissant son cycle sur le couple d'hôtes *Ribes-Salix.* Etant donné la position sous-épidermique des Téliospores, la forme ancestrale pourrait être une rouille du groupe de *Melampsora ribesii-epitea* KLEB.

Telia hypophylla, crustacea, 0,5 cm lata, primum aurantiaco-flava dein adustiora. Teliosporae subepidermicae, 30-53X 8-16 µm, supra rotundatae ; épispora tenuis (ca. 1 µm) apice non incrassata.

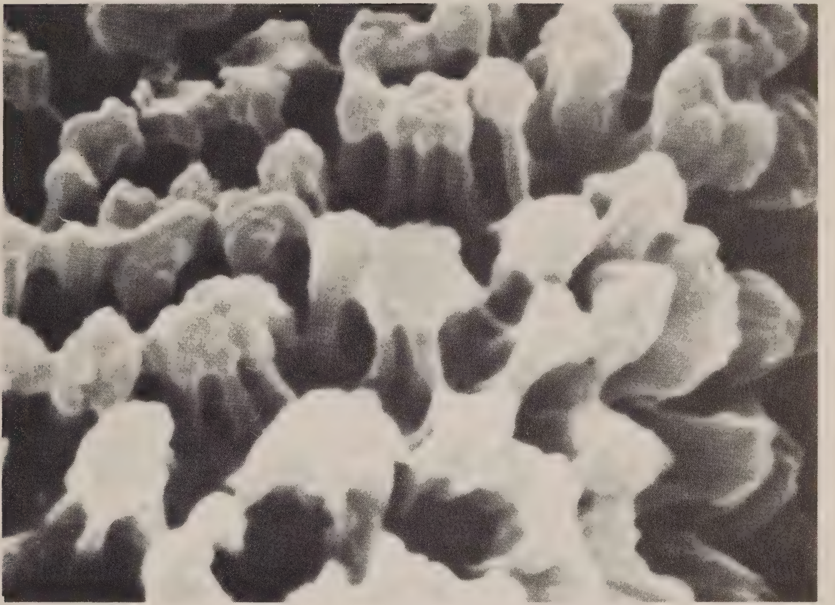


Figure 1 : Ornementation des urédospores de Coleosporium nepalense, X 17000 (M.E.B)

II foliis vivis Ribis takarae, Nepalia : in australe cacumine montis «Machapuchare» 3200 m (DURRIEU). Typus TLA 76 440.

Coleosporium nepalense n. sp.

Sur *Thunbergia cf. lutea* T. ANDERS., vallée de la Trisuli entre Thare et Dunche (district de Rasuwa) 2000 m, 2 . 10 . 76 .

Les urédosores très peu nombreux sont dispersés à la face inférieure des feuilles, ils mesurent 0, 2–0, 5 mm de diamètre. Les urédospores de forme variable, le plus souvent ellipsoides ont de 15 à 30 µm de long et 12 à 15 µm de diamètre. Leur paroi est mince environ 1 µm et densément verruqueuse, la hauteur des verrues est de l'ordre de 1, 5 µm.

L'examen en microscopie électronique à balayage montre que cette ornementation (fig 1) rappelle celle observée chez un certain nombre d'autres *Coleosporium* comme *C. campanulae* LEV., *C. cacaliae* (DC) OTTH. (HIRATSUKA et KANEKO). Ce sont des éléments constitués d'une tête irrégulière, bosselée, portée par un pied qui parait résulter de l'agglomération de plusieurs racines. Toutefois les épaississements annulaires superposés présents sur les «racines» des espèces citées n'éxistent pas chez *Coleosporium nepalense.*

Les télies sont dispersées sur des plages de dimensions variables (jusqu'à 10 X 5 mm) elles sont très petites : 0, 1 à 0, 3 mm de diamètre et de couleur orangée tendant vers le brunâtre à maturité.

Les téliospores (ou plutôt basides) sont apparemment disposées en une seule couche sous-épidermique, elles mesurent de 26 à 50 µm de long et de 16 à 26 µm de diamètre, leur forme est donc relativement trapue, elles sont arrondies à l'extrémité supérieure et recouvertes d'une épaisse couche gélatineuse.

En 1935 H. SYDOW décrivait *Coleosporium miteri* sur une *Acanthacée* probablement *Barleria cristata*, en provenance de Naini Tal (Kumaon) il ne semble pas que l'on ait retrouvé cette Rouille depuis. La récolte ne contenait que des urédospores (et donc l'espèce n'est pas valablement publiée) qui mesuraient 20–24 X 16–20 µm, c'est-à-dire un diamètre nettement supérieur à celles décrites ici. *Coleosporium nepalense* est donc le premier *Coleosporium* décrit avec certitude sur une Acanthacée.

Uredia hypophylla, rara, 0, 2-- 0, 5 mm diametro, aurantiaca. Uredosporae ellipsoideae 15–30 X 12–15 µm, dense verruculosae, epispora hyalina, ca 1 µm crassa. Telia hypophylla, in gregibus plus minusve dispersa, minutissima 0, 1–0, 3 mm auranticaco-ochracea. Teliosporae subepidermicae, oblongae, 26–50 X 16–26 µm, apice rotundatae, gelatinoso strato valde incrassatae.

In follis vivis Thunbergiae cf. luteae. T. ANDERS, Nepalia, in valle fluminis Trisuli, inter Thare et Dunche, 2000 m (DURRIEU). Typus TLA 76091.

Puccinia commelinae n. sp.

Sur *Commelina benghalensis* L., chaîne du Mahabarat, près du col de Symbanjyang (distr. de Makwanpur), 2300 à 2400 m, 16 . 10 . 76 .

Les urédosores sont hypophylles, peu nombreux, ils mesurent 0, 3 à 0, 5 mm de diamètre, leur couleur est brun canelle. Ils contiennent des urédospores ovoïdes, mesurant 22–28 X 16–21 µm, à paroi de 1, 5 à 2 µm d'épaisseur, échinulée et percée de 2 pores germinatifs équatoriaux.

Les téliosores hypophylles, nombreux, sont très petits : 0, 1 à 0, 3 mm de diamètre. Ils restent recouverts par l'épiderme. Les uns sont disposés en cercle autour des urédosores, les autres dispersés sur toute la surface inférieure des feuilles, soit isolés soit en groupes. Leur couleur est brun très sombre. Les téliospores fusoïdes, légèrement rétrécies au niveau de la cloison mesurent 30 à 50 µm de long et12 à 21 µm de diamètre (fig 2). Leur paroi est lisse, sauf à l'apex où elle est parfois légèrement granuleuse, elle est colorée en brun, son épaisseur, comprise entre 1 et 1, 5 µm, augmente fortement à l'apex où elle peut atteindre 8 µm. Le pédicelle est presque hyalin et mesure de 5 à 25 µm de long.

C'est à ma connaissance le premier *Puccinia* décrit sur une plante de la famille des Commelinaceae. Par contre sur le même hôte ainsi que quelques autres espèces de cette famille on connaît *Uromyces commelinae* CKE, largement répandu en de nombreuses régions tropicales ou subtropicales et particulièrement en Inde.

Uredia hypophylla, rara, 0, 3–0, 5 mm diametro, cinnamomea. Uredosporae ovoidae, 22–28 X 16–21 µm, épispora echinulata 1, 5–2 µm crassa, 2 poris equatorialis aperta.

Telia hypophylla, alia circa uredium cincta, alia in tota pagine inferiore dispersa aut aggregata, epidermide tecta, atra, 0, 1–0, 3 mm diametro. Teliosporae fusiformae, supra conico-attenuatae, medio leniter constrictae, 30–50 X 12–21 µm, epispora levis, apice interdum leniter granulosa, brunnea, 1–1, 5 µm crassa, apice usque 8 µm incrassata ; pedicellus subhyalinus, 5–25 µm longus.

In foliis vivis Commelinae benghalensis L., Nepalia : prope Symbanjyang furcas in Mahabarat jugo ; 2300–2400 m, (DURRIEU). Typus TLA 76322.

Puccinia mallae n. sp.

Sur Clematis barbellata EDGW., vallée de la Marsyandi entre Chame et Bagarchap (distr. de Manang) de 2400 à 2800 m, 4 . 10 . 77 .

Je dédie cette espèce au Dr S.B. MALLA Directeur du «Department of Medicinal Plants» à Kathmandu.

Les spermogonies apparaissent à la face supérieure des limbes sur de petites taches très légèrement déformantes. Leur nombre varie, sur chaque tache, de quelques unités jusqu'à une cinquantaine.

Les téliosores se forment également sur la face supérieure des feuilles, ils sont disposés en cercles concentriques autour des spermogonies, leur forme est généralement allongée : 0, 5–1 X 0, 2 mm. Ils sont pulvérulents, entourés par l'épiderme éclaté, de couleur brun sombre.

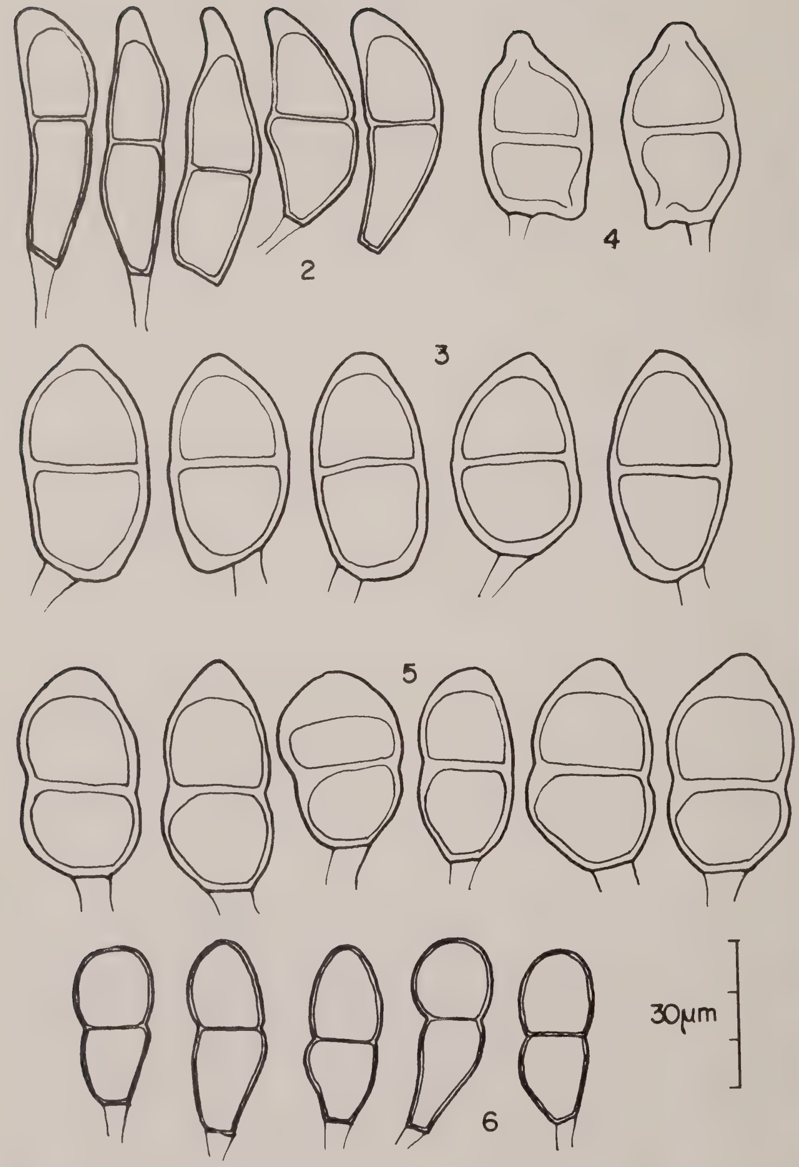
Les téliospores (fig 3) sont ovoïdes, elles mesurent 34 à 46 µm de long et 20 à 26 µm de diamètre (en moyenne 39 X 23).

Leur paroi, lisse, est brun foncé, son épaisseur varie entre 2, 5 à 3, 5 µm légèrement plus au niveau des pores germinatifs (jusqu'à 6 µm). Le pore de la cellule inférieure est situé près du pédicelle, parfois même au pôle opposé au pore apical, le pédicelle étant alors rejeté sur le côté. Ce pédicelle est hyalin, il atteint 70 µm de long.

Cette espèce est certainement proche de *Puccinia wattiana* BARCL, connu sur divers Clematis himalayens (et que j'ai même récolté dans le voisinage immédiat sur *Clematis connata).* La disposition des téliosores en cercles concentriques, la situation des pores germinatifs souvent aux deux pôles opposés de la téliospores sont des caractères que l'on retouve dans ces deux Rouilles. Mais les différences sont bien tranchées :

- Les spermogonies de *P. wattiana* sont bien moins nombreuses, on n'en observe souvent qu'une seule par tache, et plus souvent encore, le centre des cercles de spores est occupé par un gros téliosore.

- La forme générale des téliospores est nettement plus trappue chez *P. mallae* ou le rapport longueur sur largeur est voisin ou inférieur à 1, 6 alors qu'il est proche de 2 chez *P. wattiana* (fig 4). En outre si les pores germinatifs sont disposés de la même façon dans les deux espèces, ils sont surmontés d'une papille très proéminente chez *P. wattiana* qui ne se retrouve pas chez *P. mallae* : on observe un épaississement progressif et souvent peu marqué de la paroi qui s'inscrit dans le contour général de la



Figures 2–6 : Téliospores de Puccinia commelinae (2), Puc. mallae (3), Puc. wattiana (4) Puc. manangensis (5), Puc. pilearum (6).

spore, l'emplacement du pore est signalé par une zone plus claire. La paroi est nettement plus mince chez P. wattiana : 2 µm seulement.

Spermogonia epiphylla, minutas maculas leniter deformantes insidentia, plerumque numerosa (usque ad 50).

Telia epiphylla, circa spermogonia circulariter secus plures series disposita, minuta, oblonga 0, 5–1 X 0, 2 mm, pulverulenta, epidermide cincta, atra. Teliosporae ovoideae, medio non constrictae, 34–46 X 20–26 µm, epispora brunnea, levis, 2, 5–3, 5 µm crassa, usque 6 µm incrassata ad poros, porus cellulae inferioris basi positus, pedicellus hyalinus usque 70 µm longus.

In foliis vivis Clematidis barbellatae EDGW., Nepalia : in valle fluminis Marsyandi inter Chame et Bagarchap, 2400–2800 (DURRIEU)

Typus TLA 77329, isotypus in KTH.

Puccinia manangensis n. sp.

Sur *Clematis cf. orientalis* L., vallée de la Marsyandi entre Braga et Ghyaru, (district de Manang) 3400 m, 2 . 10 . 77.

Les téliosores se développent à la face inférieure des feuilles, parfois aussi sur les pétioles. Ils provoquent de légères déformations. Ils constituent des coussinets compacts, durs, rapidement dénudés sauf quelques lambeaux d'épiderme qui peuvent subsister, leur couleur est brun sombre, ils mesurent 2 à 4 mm de diamètre (parfois jusqu'à 6 mm) .

Les téliospores (fig 5) ont un contour largement ovale, légèrement resserré au niveau de la cloison, largement arrondi à l'apex et à la base. Elles mesurent 35 à 45 µm de long et 19 à 27 µm de diamètre (parfois jusqu'à 30 µm) . La paroi brun foncé, lisse, a une épaisseur de 1, 5 à 2 µm, elle s'épaissit considérablement vers l'apex où elle mesure de 5 à 11 µm. Le pore germinatif de la cellule inférieure, peu visible, est situé au contact de la cloison médiane. Le pédicelle est très légèrement coloré dans sa partie la plus proche de la spore, sa longueur varie entre 20 et 60 µm.

Je n'ai pu déceler la présence de spermogonies, on peut supposer toutefois, que comme les autres formes téliennes de *Puccinia* connues sur *Clematis* il s'agit d'une espèce autoxène microcyclique.

Deux autres espèces parasitant les *Clematis* ont également de gros sores compacts, ce sont *P. clavata* SYD en Nouvelle Zélande et *P. atragenicola* (BUB) SYD. en Europe, mais ils se distinguent par des téliospores de forme et de dimensions totalement différentes : 42–62 X 14–22 µm pour la première et 44–82 X 15–24 pour la seconde.

Puccinia manangensis ne se rapproche donc d'aucune des espèces déjà connues sur *Clematis.*

Telia saepius hypophylla, rarius petiolicola, leniter deformantia, pulvillulata 2–4 (6) mm, compacta, denudata, atra. Teliosporae late ellipsoideae, utrinque rotundatae, medio vix constrictae, 35–45 X 19–27 µm. Epispora levis, 1, 5–2 µm crassa, apice 5–11 µm incrassata, brunnea ; porus cellulae inferioris ad septam instructus. Pedicellus 20–60 µm longus, hyalinus, ad sporam pallide castaneus.

In foliis Clematidis cf. orientalis L., Nepalia, in valle fluminis Marsyandi inter Braga et Ghyaru (prope Manang) 3400 m (DURRIEU).

Typus TLA 77252 isotypus in KTH.

Puccinia pilearum n. sp.

Sur *Pilea umbrosa* WEDD., vallée de la Kali Gandaki, entre Ghasa et Lete (district de Mustang) 2200 m, 26 . 9 . 77 (type) ; Phulchauki Danda, (Kathmandu) 2000 à 2500 m, 31 . 10 . 76 .

Sur *Pilea scripta* WEDD., vallée de la Trisuli, près de Dunche (district de Rasuwa) 1600 m, 2 . 10 . 76 ; vallée de Lantang, 2000 m, 3 . 10 . 76 ; vallée de la Kali-Gandaki entre Tato Pani et Titre 1400 m et près de Ghasa, 1800 m (district de Mustang) 26 . 9 . 77 .

Les urédosores jaunes très pâles et blanchissant à la dessication s'observent sur les deux faces du limbe, ils sont petits : 0, 2 à 0, 7 mm et associés en faible nombre (1 à 4) sur des taches d'environ 2 mm de diamètre. Il y a transformation progressive en téliosores qui se présentent sous le même aspect. Du fait de la croissance mycélienne ils sont souvent disposés en cercles autour de taches, desséchées au centre, qui peuvent atteindre 3—4 mm de diamètre.

Les urédospores, ovoïdes, mesurent 22 à 30 µm de long et 14 à 20 µm de diamètre, leur paroi est mince (inférieure à 1 µm) hyaline et peu densément verruqueuse : les verrues ont moins de 1 µm de haut et sont distantes de 2 à 3 µm.

Les téliospores (fig 6) ont une forme souvent assez irrégulière, elles sont plus ou moins resserrées au niveau de la cloison transversale, en général arrondies à l'apex et atténuées à la base. Leur longueur varie entre 26 et 43 µm (35 µm en moyenne) leur diamètre est compris entre 13 et 21 µm. Le pédicelle hyalin peut atteindre 30 µm de long. La paroi est lisse, mince (1 µm) incolore. Les pores germinatifs ne sont pas visibles, mais comme ces téliospores leptosporiques germent dans le sore même, on constate que la baside supérieure sort par l'apex, tandis que l'inférieure germe au contact de la cloison transversale.

Il n'est pas possible de préciser le cycle de cette Rouille car je n'ai pu déceler, sur aucun échantillon, la présence de pycnides. Il serait également interressant de savoir si, plus tard en saison, ne se différencieraient pas des téliospores de conservation à paroi plus épaisse.

Il existe dans l'Himalaya *Puccinia urticae* BARCLAY (1889) qui est très différent de celui-ci : il ne possède pas d'urédospores et ses téliospores plus longues ont une paroi épaissie à l'apex et fortement colorée : il s'agit probablement d'une forme microcyclique dérivant du *Puccinia caricis* s. l. dont les écidies se développent sur divers *Urtica.*

Il serait par contre possible que ce champignon soit analogue à *Uredo pileae* BARCLAY (1891) découvert près de Simla et dont les urédospores jaune très pâle mesurent 20–25 X 14–20 μm. Je n'ai pu en obtenir du matériel pour comparaison, mais l'absence presque complète de pigmentation et les dimensions voisines sont des présomptions très importantes. Il parait en outre curieux que cette Rouille qui semble relativement fréquente n'ai jamais été observée auparavant. Il faut toutefois remarquer que sur plusieurs échantillons le développement très abondant d'un hyperparasite *(Gloeosporium sp ?)* masque presque totalement le *Puccinia.*

Uredia amphigena, in minutis maculis (2 mm diametro) pauca disposita, pallide flavida, in sicco expallescentia. Uredosporae ovoïdeae, 22–30 X 14–20 µm, epispora tenuis (1 µm), hyalina laxe verrucosa. Telia uredosoris conforma, saepe circa dessicatam maculam circulariter disposita. Teliosporae in teliis celeriter germinantes, ovoïdeae, apice rotundatae, basi attenuatae, medio leniter constrictae, 26–43 X 13–21 µm ; epispora levis, tenuis (1 µm), hyalina ; pedicellus usque ad 30 µm, longus.

In foliis vivis nonnullarum specierum Pileae, Nepalia inter 1400 et 2000 m altitudine. (DURRIEU).

Typus in Pilea umbrosa TLA 77148, isotypus KTH.

Puccinia heraclei-nepalensis n. sp.

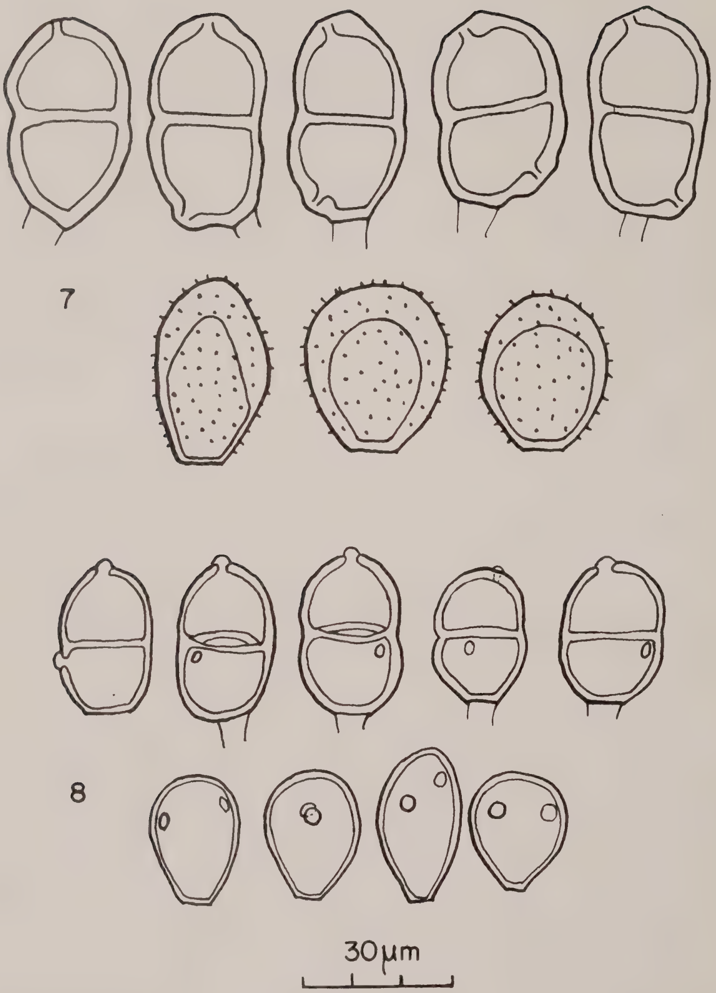
Sur *Heracleum nepalense* D. DON, vallée de Trisuli, entre Grang et Thare (district de Nawakot) 2000 m, 1 . 10 . 76 (Type). Entre Ulleri et Ghorepani (district de Parbat) 2100 m, 24 . 09 . 77 .

Les téliosores, dispersés sur les deux faces des feuilles, sont beaucoup plus abondants à la face supérieure. Ils sont petits : 0, 2–1 mm, nus, pulvérulents entourés par l'épiderme éclaté, leur couleur est brun très sombre, presque noire.

Quelques rares urédospores sont présentes mélées aux téliospores, elles sont sphériques ou ovoïdes et mesurent 28–36 X 26–30 μm. Leur paroi est couverte d'échinulations espacées de 3 à 4 μm, elle est fortement épaissie vers l'apex (jusqu'à 10 μm), et incolore comme le contenu. D'après les échantillons il est difficile de savoir s'il existe dans le cycle de ce champignon un stade urédo bien développé ou si les quelques spores observées et visiblement stériles ne représentent qu'un vestige de ce stade dans le cycle d'une microforme. Etant donné le grand nombre de téliosores de petite taille et dispersés, je penserai plutôt qu'ils résultent d'une multiplication passant par un stade urédo et que des observations plus précoces permettront de déceler.

Les téliospores (fig 7) sont de forme ellipsoide, très peu ou pas retrécies au niveau de la cloison transversale, arrondies aux deux extrémités. Elles mesurent 35–52 X 23–32 μm, le plus souvent 39–45 X 25–27 μm. L'épispore est lisse, sauf parfois autour des pores germinatifs où elle paraît très légèrement chagrinée. Elle est relativement épaisse : 2, 5–3 μm, un peu plus au niveau des pores : 4 μm. Le pore supérieur n'est pas toujours situé à l'apex, mais assez souvent déjeté latéralement, celui de la cellule inférieure est situé dans la moitié inférieure de cette cellule. Le pédicelle est très court, 5 μm environ.

Ce *Puccinia* ne correspond à aucune des espèces connues jusqu'à présent sur *Heracleum* : l'une d'entre elles a des téliospores à surface réticulée : *P. heraclei* GREV.



Figures 7–8 : Téliospores et urédospores de Puccinia heraclei-nepalensis (7), Puc. annapurnae (8).

forme à cycle complet, répandue en Europe et Asie. Dans la deuxième *P. heracleicola* CUM. (1943) du Cachemire les téliospores sont verruqueuses tandis que chez la troisième : *P. corteyi* RAN. endémique des Alpes du Dauphiné ces téliospores sont lisses, mais plus petites : 20–45 X 16–25 µm, de plus il s'agit d'une espèce microcyclique formant de gros sores atteignant 2 cm de diamètre.

Telia amphigena, sparsa, praecipue copiosissima in pagina superiore, parva : 0, 2–1 mm diametro, nuda, pulverulenta, epidermide rupta cincta, atra : Aliquot uredosporae teliosporis intermixtae ; sphaericae vel ovoïdeae, 28–36 X 26–30 µm ; epispora apice ad 10 µm incrassata echinulata, echinulae 3–4 µm intervallis dispositae. Teliosporae ellipsoideae, medio non vel vix constrictae, utrinque rotundatae, 35–52 saepius 39–45 µm longae, 23–32 saepius 25–27 µm diametro ; epispora levis, interdum circa poros subtiliter rugosa, 2, 5–3 µm crassa ad poros leniter incrassata (4 µm) , porus cellulae superioris apicalis aut lateralis, cellulae inferioris infero dimidio dispositus, pedicellus hyalinus deciduus.

In foliis vivis Heraclei nepalensis D. DON, in Emodi montibus Nepaliae centralis, typus TLA 76071 (DURRIEU)

Puccinia annapurnae n. sp.

Sur *Polygonum polystachyum* WALL., crête sud du Machapuchare (Massif des Annapurna), de 2900 à 3200 m, 24 . 10 . 76 .

Les urédosores sont dispersés sur les deux faces des feuilles, ils sont petits : leur diamètre est inférieur à 1 mm et de couleur brun canelle. Les Urédospores (fig 8) largement ellipsoides mesurent 20–27 X 18–21 µm, leur paroi mince : 1, 5 µm, percée de 2 pores germinatifs supraéquatoriaux est régulièrement échinulée : les épines sont distantes de 1 à 2 µm.

Les téliosores sont petits (inférieurs à 1 mm de diamètre) souvent très nombreux surtout à la face inférieure des feuilles, ils sont pulvérulents, brun assez foncé. Les Téliospores (fig 8) largement ellipsoides, arrondies aux deux extrémitées, légèrement rétrécies au milieu, mesurent 26 à 36 µm de long et 18 à 23 µm de diamètre, le plus souvent 28–32 X 19–22, leur paroi est mince, environ 1 µm, et lisse. Les pores germinatifs sont couverts d'une papille hyaline réduite (1 à 2 µm de haut), le pore de la cellule inférieure est toujours situé au contact de la cloison transversale. Le pédicelle est hyalin, en général entièrement caduc.

La forme de ces téliospores est voisine de celles de *P. nitidula* TRANZS, et de *P. sibirica* TRANZS. La première espèce se distingue par le pore de la cellule inférieure situé près de la base, la seconde par ses dimensions plus faible ; en moyenne 24 X 21 µm. Dans les deux cas les urédospores sont sphériques et possèdent 3–4 pores germinatifs équatoriaux, au lieu de deux supraéquatoriaux chez *P. annapurnae.*

Urédia amphigena, minuta, cinnamonea. Uredosporae late ellipsoideae, 20–27 X 18–21 µm, epispora tenuis : 1, 5 µm, echinulatis 2 poris supra equatoriis instructis.

Telia amphigena, pulverulenta, brunnea. Teliosporae late ellipsoideae, utrinque rotundatae, medio leniter constrictae, 26–36 X 18–23 µm saepius 28–32 X 19–22 µm, epispora levis, tenuis (1 µm) pori papilla minuta hyalina aucti, porus cellulae inferioris ad septum : pedicellus hyalinus deciduus.

In foliis vivis Polygoni polystachyi WALL, Nepalia, in cacumine australe montis Machapuchare (prope Annapurna) 2900–3200 m (DURRIEU)
Typus TLA 76453.

Je remercie tout particulièrement MM. F. BLASCO (Toulouse) J.F. DOBREMEZ (Grenoble) et P.R. SHAKYA (Kathmandu) qui m'ont fait profiter de leur compétance dans la détermination des hôtes ainsi que M. G. VIENNOT-BOURGIN (Paris) pour sa critique du manuscrit.

BIBLIOGRAPHIE

BARCLAY, A. 1889. Descriptive list of the Uredineae occuring in the neighbourhood of Simla (Western Himalaya) II. *J. Asiatic Soc. Bengal* 58 : 232–251.

BARCLAY, A. 1891. Additional Uredineae from the neighbourhood of Simla. *J. Asiatic Soc. Bengal* 60 : 211–230.

CUMMINS, B. 1943. Uredinales from the northwest Himalaya. *Mycologia* 35 : 446–458.

HIRATSUKA, N. & S. KANEKO. 1975. Surface structure of Coleosporium spores. *Rept. Tottori Mycol. Inst.* 12 : 1–13.

SYDOW, H. & J.H. MITTER. 1935. Fungi indici II. *Ann. mycol.* 33 : 46–71.

MYCOTAXON

Vol. IX, No. 2, pp. 493-500 July-September 1979

WESTERN FUNGI: A NEW MEXICO PSATHYRELLA IN THE CYSTIDIOSAE OF SUBGENUS HOMOPHRON

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SUMMARY

Psathyrella aculeata, sp. nov., is described from the Jemez Mountains of New Mexico. Piloderma, cauloderma, and the transmogrification of Buller's term, pilocystidium, are commented upon.

In Smith's (1972) monumental summarization of his studies of the North American Psathyrellae, there are but eighteen taxa reported from the New Mexico/Arizona area of the southwest. This, is out of four hundred and fourteen species considered. The genus *Psathyrella*, as much as any, requires critical observations and notes on fresh-condition characteristics before specimens of a species are dried. Unfortunately, there have been few regular collectors of southwestern agarics who have provided critical notes on the Psathyrellae and other dark-spored mushrooms of that region. The second author of this article, however, has, and his notes on some of his excellently preserved collections make it possible now to report many previously unrecognized components of the New Mexico flora. The particular species described here is a *Psathyrella* found at high elevation in the Jemez Mountain Range some 45 kilometers west of Sante Fe.

MATERIALS AND TERMINOLOGY

Reagents employed for rehydration and hyphal analysis of dried material include a 2:1 chloral hydrate:water solution (CH), 3% KOH, and Melzer's reagent (MR). Slide mounts were moderately hot-plate heated (without boiling) for best revival. Spore width measurements are given in face view followed by profile or side view. Abbreviations, in addition to those for reagents, include $\bar{x}$ (mean or range of means), ± (more or less), L:W (ratio of spore length to face view width), w&c (wall and content), and nd (not distinctive). When nd, the wall is smooth, thin and colorless. Numbered color terms are from Kornerup & Wanscher (1967). Portions of the type collection are deposited in the University Herbarium (MICH) and the National Fungus Collections (BPI).

In describing microstructure, terms such as pilocystidia, caulocystidia, piloderma and cauloderma are used which have prefixes denoting location on the fruiting body. These four terms obviously refer to cystidia and surface layers of the pileus and stipe, and some have been used previously in studies on the genus *Coprinus* (Patrick, 1977). The latter two, piloderma and cauloderma, are derived directly from the former two which were instituted by Buller (1924). Buller coined locational or topographic terms for cystidia (including pleurocystidium and cheilocystidium) by combining Greek word elements. The unfortunate alteration of one of his original terms, pilocystidium, to "pileocystidium" is inappropriate and ought to be unacceptable to mycologists. Buller's term, as a compound word, is both orthographically correct (see Rec. 73G, Stafleu et al., 1978, and Nicolson & Brooks, 1974) and specifically definitive. One need only consider the common meaning for the Greek word *pilos*: a hat or cap. The prefix of Buller's compound was not qualitatively based upon the latin word *pilus* (a hair, for hair-like cystidia), and so there is no need to make the term locationally specific by changing the prefix to "pileo" (an incorrect compounding form anyway). Pilocystidium, spelled correctly and as a term, then, has literally and simply just the meaning Buller intended, a cystidium located on the cap.

DIAGNOSIS AND DESCRIPTION

Psathyrella aculeata Patrick & Barrows, sp. nov.

Discrepans a taxis affinibus ad zona transitionis inter sectionibus *Homophron* et *Pannucia* (*P. solitaria, P. stuntzii, P. carbonicola*) combinatione (inter alios characteres) habitus cespitosi, habitationis montani, substrati ecarbonacei, staturae parvae, coloris pallentis, veli exiqui, lamellarum latorum aliquantulo decurrentium, stipitis bulbosi, sporarum cylindricorum parvorum, cystidiorum hymeniorum partiete crasso pigmentifero incrustato, et caulocystidiorum interdum ramosorum collis longis flexuosis; holotypo (C. Barrows 1978-3) in herbario Universitatis Michiganis asservato.

Basidiocarps moderately small, cespitose to closely gregarious on soil, in montane habitat (ca. 2700 m) with *Pinus ponderosa* and *Pseudotsuga taxifolia*, July.

Pileus ca. 1.5-3.5 cm across, becoming broadly convex, warm buff with thin delicately fibrillose velar covering, the white veil evanescent except for slight remnants on margin; surface smooth and not otherwise distinctive.

Lamellae moderately broad, broadly adnate (often with slight decurrent tooth), close, grayish buff before becoming darker brown (in sicco dark purple-brown); edges entire, silvery with cystidia.

Stipe short but rather robust (at least in larger specimens), bulbous, ca. 1.5-4 cm by 2-7 mm, ± equal above base, hollow; surface minutely pruinose at apex, otherwise floccose-fibrillose to slightly scaly except on base where heavily white-mycelioid tomentose, lacking an annular zone (unless evanescent), almost white; rhizomorphs present as fine white threads, inconspicuous in soil balling around base.

Odor none. *Taste* mild.

Spores 7-9 × 3.7-4.2 × 3.7-4(4.2) µm ($\bar{x}$ 7.6-7.9 × 4.0 × 4.0), L:W 1.75-2.06 ($\bar{x}$ 1.94-1.95), in face view (fig. 1) subcylindric with rounded apex and base, in profile inequilaterally subcylindric to slightly allantoid, terete; germ pore apical but obscure (less than 0.5 µm diam); basal appendix minute but distinct, strongly adaxial; wall smooth, moderately thick (ca. 0.7 µm), transluscent and chocolate brown in KOH (near 6F5, Teak), not appreciably darkening (in CH dark brown with reddish cast, in MR dark red-brown); content multiguttulate or with 1-2 huge refractive globules.

Basidia tetrasporous, 15-18 × 7-8 µm, broadly subclavate (fig. 4), with short curved-acicular sterigmata (2-2.5 µm); w&c nd. *Basidioles* nd. *Lamella Trama* of subparallel, mostly inflated hyphae with moderate to frequent branching, in mass light brownish vinaceous (CH); cells narrowly cylindric to broadly elliptic, 3-30 µm diam; wall smooth, thin, ± colorless; content nd.

Pleurocystidia gregarious (most densely abundant toward margin), 30-46 × 9-13 µm, fusoid-ventricose to subfusoid (fig. 2), but broadest below and in most with long neck acutely tapering to sharp apex, infrequently furcate above; wall appearing weakly to moderately thickened in KOH, 0.5-1(1.5) µm, conspicuously pigmented brownish ochraceous except at and near apex where decidedly thinner and ± colorless, with surface often slightly incrusted by amorphous material (in CH with vinaceous brownish wall color, in MR golden ochraceous); content nd in all reagents. *Cheilocystidia* profusely abundant (margin ± sterile), dimorphic: 1) subfusoid-ventricose with long, straight or flexuous neck and an acute apex, 26-38 × 7-10(12) µm, the wall colorless to often thickened and pigmented as in pleurocystidia, with neck and apex often slightly ornamented with crystalline incrustment (KOH); 2) shorter, less numerous and mostly spheropedicellate, 12-21 × 5-12 µm, with wall occasionally becoming slightly thickened and brownish ochraceous overall; content nd in both forms.

Pilocystidia absent. *Piloderma* a well differentiated epithelium of approximately two cell layers depth, the lower of generally larger and more radially elongate elements; cells globose to broadly elliptic, usually large, 17-55 × 14-40 µm; wall smooth to slightly incrusted, colorless to brownish ochraceous (though distinctly less ornamented and pigmented than the subtending trama hyphae); content nd. *Pileus Trama* of ± radially oriented, narrow to moderately broad filaments with frequent branching, in mass reddish brown (KOH); cells cylindric to elongate elliptic, 3-20 μm diam; wall usually somewhat thickened and slightly to heavily incrusted with ochraceous brown material; content nd.

Caulocystidia present only at and near apex where abundant in great cespitose clusters, versiform but primarily subfusoid-ventricose (fig. 3), with long ± flexuous neck and acute apex (ca. 34-60 × 8-18 μm), also with

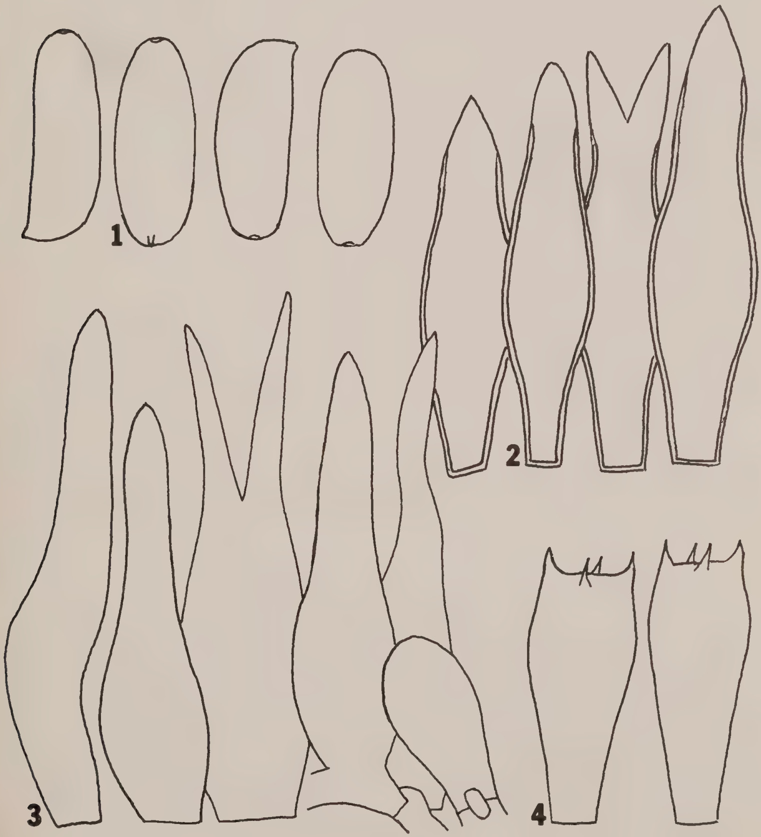

Fig. 1-4. Line drawings of microscopic structures. 1. Spores (×3500). 2. Pleurocystidia (×1600). 3. Caulocystidia (×1600). 4. Basidia (×2000).

smaller, ovoid to broadly clavate cells (ca. 12-18 × 8-13 µm); w&c nd. *Cauloderma* at mid-stipe level of narrow, infrequently branching hyphae, ± fasciculate or strand-forming (though loosely so), with fascicles or strands moderately interwoven among themselves; cells cylindric, 4-10 µm diam; wall nd except for inconsistent ornamentation by coarse, dingy yellowish, oxalatoid crystals; content nd. At stipe base, cauloderma a thick tomentum of loosely but intricately interwoven, fine, ± flexuous hyphae, the filaments moderately branching and essentially non-fasciculate; cells cylindric, 3-5 µm diam; w&c in general nd. *Stipe Trama* of vertically parallel rarely branching hyphae, in mass vinaceous brownish (KOH); cells rather short and mostly inflated (± barrel-shaped), ca. 28-60 × 4-26 µm; wall slightly thickened and often ornamented at or near the septa with conspicuously refractive, brownish ochraceous material; content nd.

Veil Remnants on pileus (pilocalyptra[1]) of interwoven moderately broad filaments, the hyphae rather close-septate and little to non-fasciculate, with occasional to moderate branching; cells cylindric, short and relatively broad to less often long and narrow, 3-13 µm diam; w&c nd. On stipe, caulocalyptra not distinquished (see stipe base cauloderma).

Clamp Connections abundant and conspicuous throughout the fruiting body.

Material examined. USA: New Mexico: Sandoval County: C. Barrows 1978-3 (MICH, BPI), Jemez Mountains, 13-vii-1978.

OBSERVATIONS

The basidiocarps of this species are macroscopically characterized by the short but sturdy and non-delicate stature, the fine white universal veil, the broadly adnate-toothed lamellae, and the bulbous stipe base. Distinctive developmentally and ecologically are the more or less cespitose habit, terrestrial substrate, and altitudinally high and coniferous habitat. Also, the light-colored pileus is noteworthy. Warm buff is not the yellowish colored "warm buff" of Ridgway (1912), but rather, according to the second author, "the buff of the artist obtained by tinting white with a bit of brown, producing a neutral color which, however, if it has a little more red in it, an artist would call 'warm'." The pileus in the fully dried herbarium specimens, however, is much darker brown (± between 5E6, Mustard Brown, and 6E7, Cognac).

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[1] Etym: καλυπτρα (veil) on πιλοσ (cap).

Microscopically, the spore shape and obscurity of the germ pore is distinctive, as are the shapes, dimensions, wall thickening, ornamentation and pigmentation of certain of the cystidia. The incrustation of the pileus hyphae is also important, as is the coloration of the whole trama system when revived in standard chloral hydrate or potassium hydroxide. Structurally, the veil material may also be of taxonomic significance when veil structure has been characterized more widely in *Psathyrella.*

TAXONOMY

In the modern infrageneric classification for *Psathyrella, P. aculeata* is properly placed in Smith's (1972) section *Cystidiosae* of subgenus *Homophron.* However, as Smith (l.c.) has pointed out, the demarcation between certain taxa in the *Homophron* and certain within subgenus *Pannucia* is fine. *Pannucia* species in general are more heavily velate and have thinner-walled and unornamented cystidia. The position of *P. aculeata* is clearly at this *Homophron*/*Pannucia* boundary, and it could be considered about as closely related to *P. carbonicola* A.H.Sm. in the *Pannucia* (stirps *Minutisperma*) as to *P. stuntzii* A.H.Sm., or other *Cystidiosae,* in subgenus *Homophron.* Of course, *P. carbonicola* {a species incorrectly synonomized with the Friesian *P. pennata* (Dennis et al., 1960; see Smith, l.c. p. 224)} differs from *P. aculeata* by its differently shaped and slightly smaller spores, as well as its usually colorless and scarcely thickened cystidial walls, narrow and simply adnate lamellae, and non-bulbous stipe. *Psathyrella carbonicola* also has consistently been found on a carbonaceous substrate.

In subgenus *Homophron, P. solitaria* A.H.Sm. has pigmented and similarly thickened hymenial cystidia. However, that species differs from *P. aculeata* in habit, habitat, basidiocarp size, stature and color, and spore width and shape in face view. *Psathyrella stuntzii* seems closely related by habitat and by the fact that its pleurocystidia (except for their flexuousness) are very similar. However, its spores differ from those of *P. aculeata* both in the submitriform-ovate shape and in their larger size. And, the caulocystidia of *P. stuntzii* are not at all like those of *P. aculeata*.

ACKNOWLEDGMENTS

The authors express sincere appreciation to Dr. Kenneth Harrison, Acadia University, for his review and improvements to the manuscript and to all others who aided in any way.

LITERATURE CITED

Buller, A.H.R. 1924. Researches on Fungi. Vol. III. Longmans, Green & Co., London. 611 p.

Dennis, R.W.G., P.D.Orton & F.B.Hora. 1960. New Checklist of British Agarics and Boleti. Suppl. Trans. Brit. Mycol. Soc. 225 p.

Kornerup, A. & J.H.Wanscher. 1967. Methuen Handbook of Colour. Ed. 2. Methuen Co., London. 243 p.

Nicolson, D.H. & R.A.Brooks. 1974. Orthography of Names and Epithets: Stems and Compound Words. Taxon 23:163-177.

Patrick, W.W. 1977. The North American Species of *Coprinus*: Terricolous and Lignicolous Taxa in Sections *Insignes*, *Veliformes*, and *Hemerobii*. Ph.D. Dissertation. University of Michigan, Ann Arbor. 325 p.

Ridgway, R. 1912. Color Standards and Color Nomenclature. Published privately, Washington, D.C. 43 p., 53 pl.

Smith, A.H. 1972. The North American Species of *Psathyrella*. Mem. New York Bot. Gard. 24:1-633.

Stafleu, F.A., E.G.Voss et al., eds. 1978. International Code of Botanical Nomenclature, XII International Botanical Congress, Leningrad. Regnum Veg. 97:1-457.

MYCOTAXON

Vol. IX, No. 2, pp. 501-504 July-September 1979

TYPE STUDIES IN THE GENUS PEZIZA. VIII - X. SPECIES DESCRIBED BY G. MASSEE, E. K. CASH, AND F. J. SEAVER.

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With the completion of number X of this series most type collections of North American material have been studied. Exceptions are those collections described by Phillips and Harkness from California, the Schweinitz collections and a few others.

Since methods used to study dried *Peziza* material have not been previously discussed, I have outlined below my general procedures.

Material was rehydrated in water or commercial ammonia solution and sectioned either by hand or using a freezing microtome. Some material was sectioned freehand before rehydration. Sections were mounted in water, or were stained in 0.2% cotton blue in lactic acid, in Melzer's reagent, or in 0.5-1% Congo Red in ammonia. The last solution proved to be the most useful in the study of apothecial anatomy. A major difficulty in studying *Peziza* species has been that, because of the large numbers of inflated globose cells in the excipulum, the excipular cells collapse and cannot be adequately studied. The ammonia solution inflates the cells well; the stain penetrates evenly and rarely overstains. But, even with this method, not all material rehydrates sufficiently to allow detailed study. The condition under which drying takes place is most critical. Rapid but gentle drying produces the best results.

For the present study material was lent by the following institutions which I wish to thank: The New York Botanical Gardens, The National Fungus Collection, and the Cornell University Plant Pathology Herbarium. Drs. R. P. Korf and H. J. Larsen, Jr. read the manuscript and helped to improve it.

VIII. Species described by G. Massee.

Peziza martialis Massee, Bull. misc. Inf. Kew. p. 175. 1899.
On the ground, Selangor, Straits Settlement, col. Ridley. NY.

The NY specimen, which agrees with that described by Massee, is a small species of *Phillipsia*. The ascospores are bilaterally asymetrical, biguttulate, and are very finely marked with longitudinal ridges. The species seems closest to *Phillipsia minor* (Wakef.) Rifai.

Peziza morgani Massee *in* Morgan, J. Mycol. *8*: 190. 1902.
= *Jafnea fusicarpa* (Gerard) Korf fide Korf, Nagaoa *7*: 5. 1960.

Peziza nana Massee *in* Morgan, J. Mycol. *8*: 190. 1902.
On the ground, Preston, Ohio. U.S.A., col. A. P. Morgan, no. 30. NY.

This is a small species which reaches a diameter of only 6 mm. The packet in NY contains only minute fragments of the fungus which do not allow study of anatomical features.

There is no indication of apothecial color either in the original description or on the packet and accompanying drawing. The asci are J+. The ascospores are ornamented with isolated warts and short crests, are 18 - 20 x 9 - 10 µm, and are generally biguttulate, the guttules being unequal in size. Because the apothecial anatomy is unknown and color information is lacking, it is difficult to, at present, place the species. The spore ornamentation is somewhat reminiscent of *Peziza saccardoiana* Cooke.

Peziza plicata Massee et Rodw., Bull. misc. Inf. Kew. p. 158. 1901.
On partly buried branches, Rodway, 663. Tasmania. NY.

Rifai (1968) studied the material at Kew and suggested that this species should be referred to either *Hymenoscyphus* or *Discinella*. Study of the NY specimen confirms that this fungus is an inoperculate discomycete.

Barlaea subaurantiaca Massee, J. Bot. London *34*: 147. 1896.
≡ *Peziza subaurantiaca* (Massee) Rifai, Verh. K. ned. Akad. Wet., II, *57*(3): 248. 1968.
On the ground, Hamilton, Victoria, Australia. NY.

Peziza tomentosa Massee, Bull. misc. Inf. Kew. p. 175. 1899, non *P. tomentosa* Schum. ex Fr. 1822 nec. *P. tomentosa* Schw., 1832.
≡ *Lachnea tomentosa* Massee ex Sacc. & Syd., Syll. fung. *16*: 719. 1902.
On the ground, Selangor, Ridley, no. 70. NY.

This is a small species of the genus *Phillipsia*. The type material at NY is composed of a single apothecium 1 cm in diam with a short eccentric stalk. When rehydrated, the apothecium is leathery. None of the ascospores seen were mature. It is unlikely that a proper identification in *Phillipsia* will be possible with this material.

IX. Species described by E. K. Cash.

Peziza alaskana Cash, J. Washington Acad. Sci. *44*: 44. 1954.
Crocker Sta. 1, Mendenhall Glacier area, Alaska, col. R. Sprague, July 11, 1952. BPI (holotype).

This species, like *Peziza retispora* Rifai, is closely related to *P. badia*. All are dark brown, black, or purplish, are on soil, and have completely or incompletely reticulate ascospores. They differ in their ascospore and ascus size and degree of ascospore ornamentation. In this species the ascospores are 22 - 24 x 9 - 10 µm and have a nearly complete reticulum. The asci are 275 - 300 x 15 - 18 µm. The ascospores are larger than in *P. badia* Pers. ex Mérat and have a complete reticulum. The asci of the two are within the same range. The ascospores are also larger than in *P. retispora* but the asci are shorter. *Peziza alaskana* has a large-celled subhymenial layer as in *P. retispora*. Cash's original description is quite complete though her comparison of the species to *P. brunneo-atra* Desm. seems misconceived.

Aleurina stipitata Cash, Stud. Nat. Hist. Iowa Univ. *17*: 219. 1937, non *Aleurina stipitata* Rodway, Pap. Roy. Soc. Tasmania p. 117. 1924.
On soil with mosses, Prov. Chiriquí, Valley of upper Rio Chiriquí Viegio (alt. 1600 - 1800 m.), June 29, 1935. col. G. W. Martin (2130). FH (isotype).

This true *Peziza* is closely related to *P. atrovinosa* Cooke and *P. retiderma* Cooke.

The apothecia are up to 1.5 cm in diam, and when dried are black or brownish. They have a very short stalk. The asci are J+ at the tip and on the lateral walls; there is no apical ring which becomes blue. Ascospores are 9.5 - 11 x 6 - 7 µm and are marked with dark warts and short ridges. The markings are up to 2 µm high, are more or less distinct, and rarely anastomoze. The ornamentation of the spores is most like *P. retiderma* as illustrated by Rifai (1968) and Le Gal (1953). Since I have not examined the holotype of *P. retiderma* it seems imprudent at this time to propose a valid, legitimate name for this, the illegitimate *Aleurina stipitata*.

Peziza thaxteri Cash, Sydowia, Beih. *1*: 291. 1957.
≡ *Nothojafnea thaxteri* (Cash) Gamundi, Boln Soc. Argent. Bot. *13*: 279. 1971.
On moist bank in woods. Concepción, Chile, R. Thaxter. Nov. 1905. BPI (holotype), FH (isotype).

Gamundi restudied the type when proposing the combination in *Nothojafnea*. She mentioned several other collections from South America. She concluded that *N. thaxteri* was very similar to *N. cryptotricha*, an opinion which I share based on my study of the type material.

X. Species described by F. J. Seaver.

Aleurina aquehongensis Seaver, Mycologia *6*: 278. 1914.
On ground in a damp place. Oakwood Heights, Staten Island, New York. Sept. 5, 1914, col. N. L. Britton and F. J. Seaver. NY (holotype).

This fungus was described as reaching a diam of 10 mm, as being colored entirely brownish-black with a slightly olive tinted hymenium. It was said to have an irregular stem-like base. Ascospores are 15 - 16 x 7 - 8 µm long, hyaline, and then pale smoky-brown, are ornamented with thin ridges which interconnect to form an incomplete reticulum. They are sometimes slightly apiculate. The ascospores are larger in size but are like ascospores of *P. ostracoderma* Korf in their ornamentation. Asci are J+. In section the flesh is brown due to pigmentation of the walls of the hyphae. The outer surface of the apothecium is pustulate, the pustules being composed of interwoven hyphae.

The type collection consists of five apothecia all of which are smaller than reported by Seaver in the original description of the taxon. To date, the species is known only from the type locality though one collection from Massachusetts (On moist gravelly bank at edge of spring, Canton, Mass., col. D. H. Linder, Aug. 1932, FH) is very similar. These are both very close to *P. badia* in all features except their smaller ascospores. Since there seems to be a complex of species involved, no recombination in *Peziza* is offered here.

Peziza concentrica Seaver, North American Cup-fungi (operculates). p. 228. 1928.
On the ground, Humbolt Co., Carlotta, California, col. Mrs. H. E. Wilder, Jan. 22, 1914. NY (holotype).

Asci are J+. Ascospores range from 18 - 20 x 9.5 - 10.5 µm. The species was said by Seaver to have concentric rings of elevations and depressions on the inside and outside of the disc. These are evident in the dried material in which the apothecia are pale brown inside and out. I have not seen other collections with this feature. It is somewhat similar to *P. vesiculosa* but is on soil. It is tentatively accepted in the genus *Peziza* with hesitation.

Peziza melaleucoides Seaver, North American Cup-fungi (operculates). p. 225. 1928.
On ground in conifer forest, col. L. O. Overholts. Tolland, Colorado. Alt. 9000 ft., June 19, 1914. (Holotype).

This name has apparently been used in several senses. Collectors of

Discomycetes in the western states have used this name for a true *Peziza* with amyloid asci. But the type material has J- asci. A new genus to accommodate this species will be described elsewhere. The J- asci, small ornamented, biguttulate ascospores, and distinctive apothecial anatomy distinguish it from *Peziza* and from other operculate Discomycetes. There is some justification for the confusion involving this species since one of the collections Seaver identified, as *P. melaleucoides*, is an immature *Peziza*.

In the original description Seaver stated that the species was collected in June 1914. In NY there are two identical collections made in June, one on the 14th and one on the 21st. The first of these was marked type by Seaver and is the collection listed above.

Peziza pseudoclypeata Seaver, The North American Cup-fungi (operculates), Suppl. p. 332. 1942.
= *Pachyella adnata* (Berk. & Curt.) Pfist. fide Pfister, Canad. J. Bot. *51*: 2009. 1973.

Peziza waltersii Seaver, The North American Cup-fungi (operculates), Suppl. p. 332. 1942.
On much rotted wood of sugar maple and beech in beech-maple-hemlock forest, Cleveland, Ohio. Early June. Maurice B. Walters. NY (holotype). CUP (authentic).

This is a true *Peziza*. The asci are J+; the blueing reaction involved the entire ascus wall, and is faint in the type collection. The original description and fieldnotes state that the species is yellow when fresh. Yellow hymenia are seldom reported in species of *Peziza*. Boudier described several but all of these were said to have smooth ascospores. In *P. waltersii* the spores are marked with prominent isolated warts and ridges.

This species should be sought. Other than the collections made by Walters in Ohio there are only two collections from Michigan (R. P. Korf 1252, 1263) which I have seen.

Literature cited

LE GAL, M. 1953. Les Discomycètes de Madagascar. Prodr. Flore Mycol. Madagascar *4*: 1-465.

RIFAI, M. A. 1968. The Australasian Pezizales in the Herbarium of the Royal Botanic Gardens Kew. Verh. K. ned. Akad. Wet. II *57*(3): 1-295.

MYCOTAXON

Vol. IX, No. 2, pp. 505-519 July-September 1979

NOTES ON CORTICIACEAE (BASIDIOMYCETES) IV.

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SUMMARY

Subulicium nov.gen. is described with Peniophora lauta as type and characterized by acute, smooth, and lateral cystidia and with simple septate hyphae. The combination Scopuloides (Mass.) Hjortst.& Ryv. is proposed and the genus is characterized by a dense hymenium, encrusted thick-walled cystidia and simple septate hyphae. Xenasmatella decipiens nov.spec. is described, based on collections from Spain and Poland. The following combinations are proposed: Hyphoderma involutum, Phlebia longicystidia, Scopuloides hydnoides, Subulicium lautum, Subulicystidium rallum, and Xenasmatella inopinata.

HYPHODERMA INVOLUTUM (Jacks. & Deard.) Hjortst. & Ryv. nov. comb.
Basionym: Peniophora involuta Jacks. & Deard. Mycologia 43:54-55, 1951.

Fruitbody resupinate, effuse, thin and whitish, under a lens having projecting cystidia bearing brownish agglomeration of resinous matter, dissolved in KHO and Melzer;

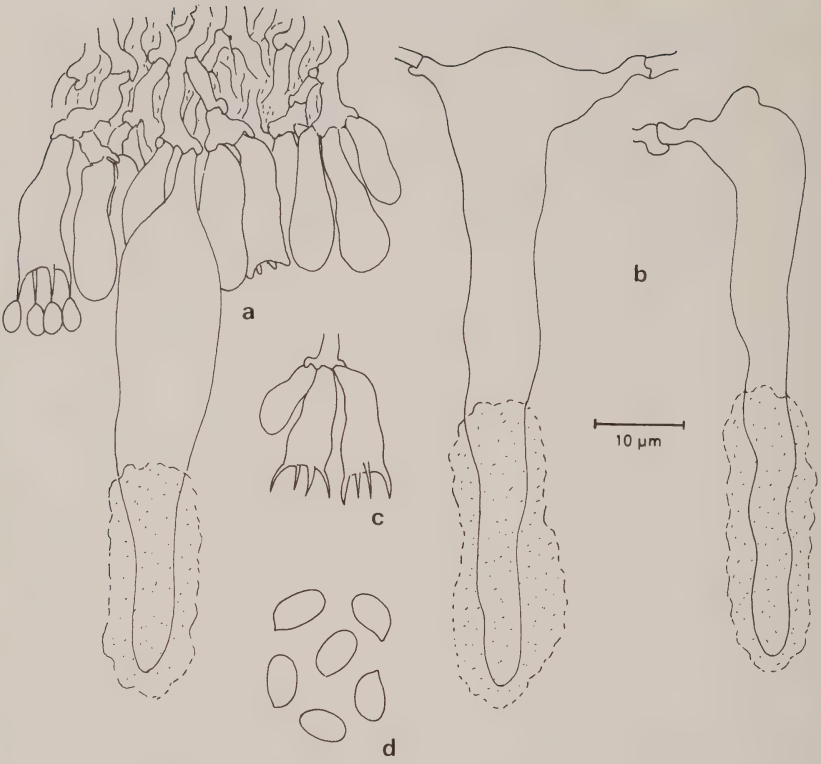

Fig. 1. Hyphoderma involutum a) part of the hymenium with cystidium partly covered with resinous matter b) cystidia c) basidia d) spores. Coll. Ryvarden 17325.

margin not differentiated. Hyphal system monomitic with hyphae somewhat indistinct,thin-walled and ab. 2.5 um wide, with clamps. Cystidia tubular, normally widened in the lower part, in some cases lateral, 60-70 um long and 10-12 um broad at the base. Basidia clavate, slightly constricted, 10-15 (-18-20) x 4-5 um, with four sterigmata. Spores ellipsoid, thin-walled, mostly 4.5-6 x 3-4 um, non-amyloid.

Habitat: Collected on Picea abies.

Specimens examined: U.S.A. Wyoming, South Brush Creek camp ground, Medicine Bow Nat. Forest, on rotting coniferous wood, July 25, 1942. S. M. Pady. Type. (TRTC).
Finland. Kuusamo, Sukkapuro, Oulaukajoki, on Picea abies. 1978-09-24.

Inger Johansen & Leif Ryvarden. Ryv. 17325. (O). Sweden. Västergötland. V. Tunhem par., Halleberg, Ovandalen, on Picea abies. 1978-09-02.K.H.Larsson.KHL 2051. Flo par., Hunneberg, Jonstorpsmossen, on Picea abies. 1978-10-15. K.H.Larsson. KHL 2497.

Remarks. Hyphoderma seems to be the most appropriate genus for this species and it may be related to H. argillaceum (Bres.) Donk. This species has larger spores and cystidia and generally also capitate hyphal ends between the basidia. Such hyphal ands are not seen in H. involutum.

PHLEBIA LONGICYSTIDIA (Litsch.) Hjortst. & Ryv. nov.comb.

Basionym: Peniophora longicystidia Litsch. Österr.Bot. Zeitsch. 77/2:131-132, 1928.

Fruitbody resupinate, effuse, adnate, when living somewhat gelatinous,when dried membranaceous to cartilaginous, hairy by projecting cystidia, in colour greyish; margin similar or slightly paler than the fertile part. Hyphal system monomitic with subicular hyphae distinctly differentiated, thick-walled and irregular, subhymenial hyphae thin-walled or slightly thickened, all hyphae about 4 um in diam., and with clamps. Cystidia cylindrical, with thickened walls, terminal and usually 90-120 x 8-9 um, sometimes up to 200 um or more and 10-12 um wide, non-amyloid, without sulfovanilline reaction. Basidia normally more than 20 um long, more or less clavate with tapering base, 4-sterigmated. Spores ellipsoid, slightly thick-walled, 7-8 x 4-5 um, variable in size, non-amyloid.

Habitat. Collections from Finland and Norway on decorticated or lumbered, coniferous wood.

Specimens examined. Austria. In monte Troppberg prope Purkersdorf, Austria inferioris, on coniferous wood. 1925-08-12. Keissler & Litschauer 223. Type (S).
Finland. Karelia, Miehikkälä, Muhikko, on lumber. 1976-08-11. Lars Fagerström, s.n. (GB, HSI).
Norway. Hedmark. Våler, Sortåa, coniferous wood. 1978-08-19. Högholen 704/78; Löten, Ö Rokoskogen, coniferous wood. 1978-09-07. Högholen 874/78 (both collections O).

Remarks. The only difference between the type and the three Scandinavian specimens seems to be that the type specimen shows thick-walled "cystidioles" (see also Weresub p. 1490, 1961) which are septate and somewhat amyloid. As the type presumably represents a somewhat undeveloped specimen, we do not believe that this difference is of taxonomical importance.

Phlebia, used in a wide sense, is no doubt heterogenous. We are at present, however, not able to find any better solution for its generic position.

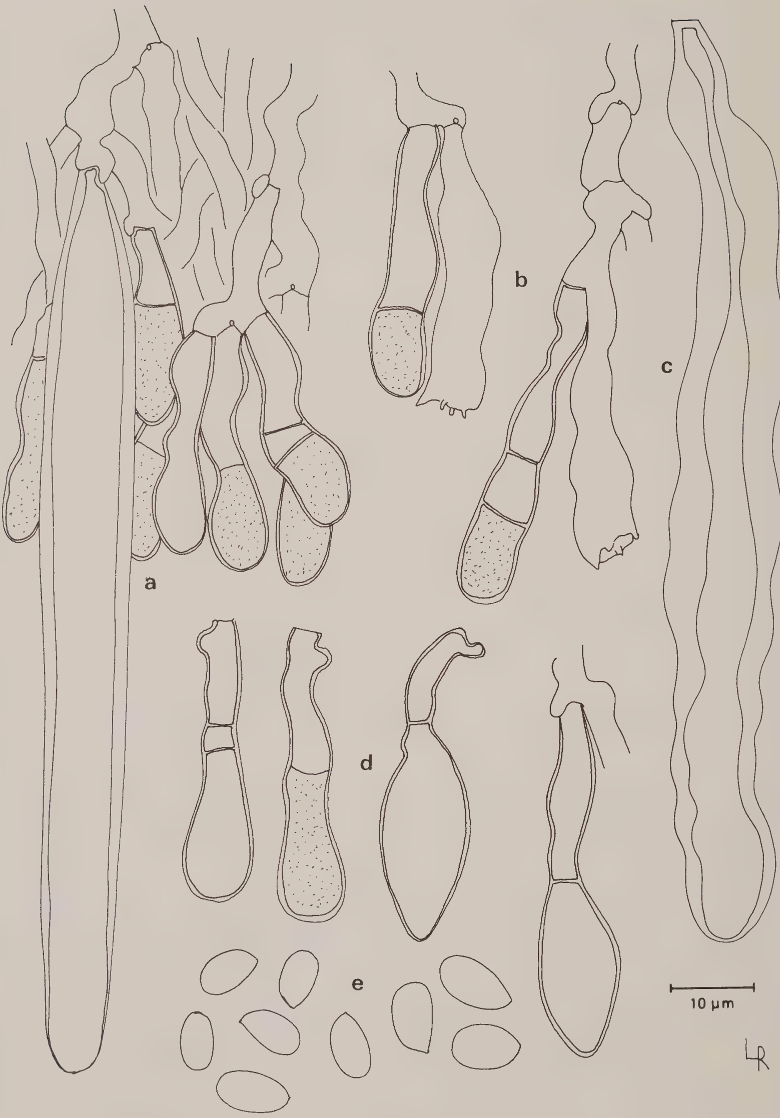

Fig. 2. *Phlebia longicystidia* a) part of hymenium with cystidium and "cystidiols" with thickened walls b) basidia and "cystidioles" c) cystidium d) "cystidioles" e) spores. From the type.

SCOPULOIDES (Massee) Hjortst. & Ryv. nov.comb.

Basionym: Peniophora subgen. Scopuloides Massee, Journ. Linn. Soc. 25: 154, 1890.

Typus generis: Peniophora hydnoides Cooke & Massee.

Höhnel and Litschauer (1908) used the name Scopuloides, but only provisionally:"Vertreter der Gattungen Aldrigea, Scopuloides (Massee als Sektion von Peniophora) and Hypochnella haben wir nicht gesehen und daher diese drei Gattungen nur provisorisch in die Tabelle aufgenommen". Thus, according to article 34 in the Botanical Code, the name is not validly published. As a generic name for Peniophora hydnoides is needed, it is herewith validated. The genus Scopuloides with the type species Peniophora hydnoides is delimited by its dense hymenium (reminding of Phlebia sensu lato) and thick-walled, strongly encrusted cystidia (metuloids). Besides, clamped hyphae are not found in this species. Metuloids occur in many other genera, and cannot therefore be used for generic separation. The same is true as to the lack of clamps. More important is the structure of the hymenium. This is in Scopuloides not composed of separable basidial bundles. The basidia are instead formed from a dense pseudoparenchymatic layer next to the basidial palisade.

A genus to consider in this discussion is Metulodontia Parm., typified by M.nivea (Karst.) Parm. This species has a quite firm fruitbody and encrusted cystidia, but has also small gloeocystidia with sulfovanilline reaction. We are of the opinion that this latter characteristic is rather important and prefer to keep Metulodontia as a monotypic genus for the time being even if Parmasto (1968) included some other species e.g. M.cremeo-alutacea Parm., M. queletii (Bourd. & Galz.) Parm., and M. roumegueri (Bres.) Parm.

Concerning further discussion about Metulodontia see Eriksson & Ryvarden (Vol. 4, p. 870, 1974).

SCOPULOIDES HYDNOIDES (Cooke & Massee in Cooke) Hjortst. & Ryv. nov.comb.

Basionym: Peniophora hydnoides Cooke & Massee in Cooke, Grevillea 16: 77, 1888.

Well-characterized species with a smooth to slightly hydnoid fruitbody, as young more or less pilose by projecting cystidia. Hyphal system monomitic with basal hyphae easily observed, thin-walled, without clamps, 3-4 um wide, subhymenial hyphae indistinct and forming a dense layer. Cystidia numerous, conical, thick-walled and strongly encrusted, sometimes lateral, especially in young fruitbodies, about 50-70 um long and 10 um broad at the base. In most specimens also obtuse, projecting hyphal ends as a rule septate, and strongly encrusted. Basidia small, about 8-12 x 3-5 um,

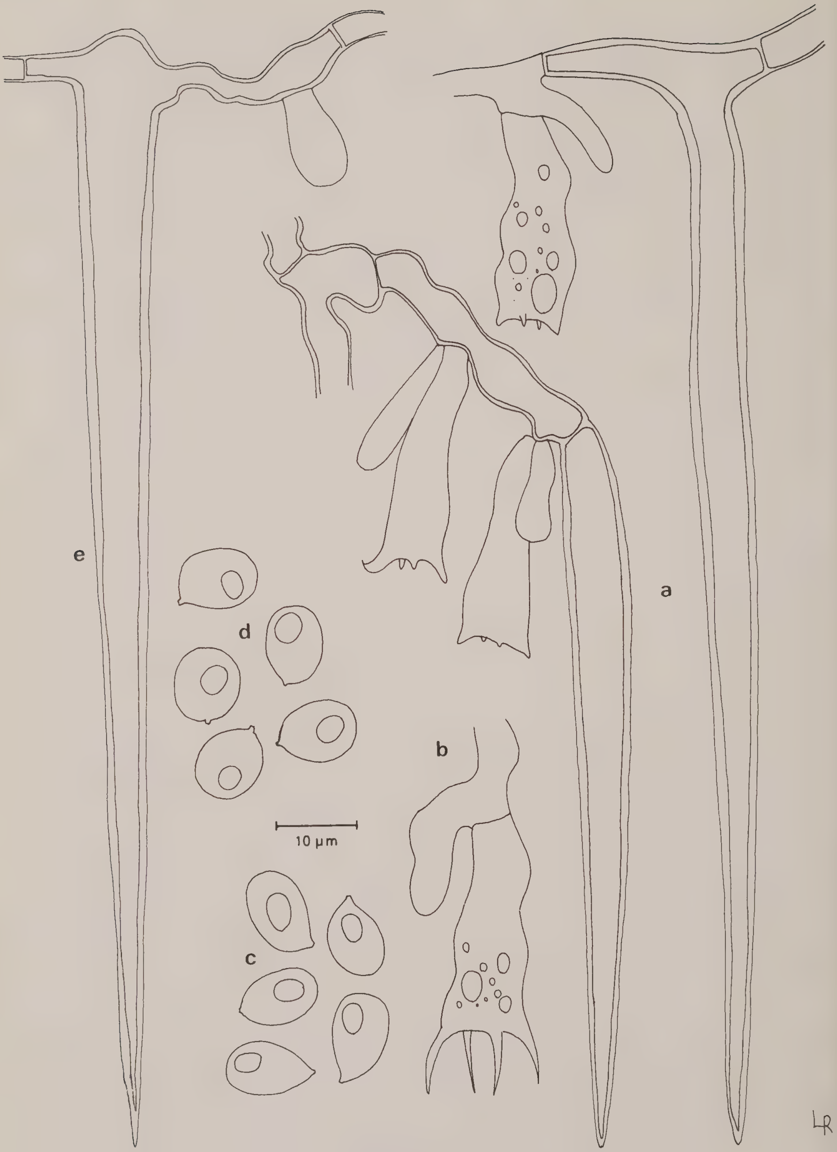
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Fig. 3. Subulicium lautum a) cystidia b) basidium c-d) spores e) cystidium. - a-c from the type, d-e from Jackson 21120.

with four sterigmata. Spores generally suballantoid to short cylindrical, smooth and thin-walled, 4.5-5 x 2-2.5 um, non-amyloid.

Habitat. Usually on deciduous trees, rarely on coniferous wood. Both on corticated as well as on decorticated wood.

Distribution. In S. Scandinavia a very common species at least in favourable localities. According to Strid (1975) the species is commonly distributed in the northern inland, less common in coastal localities.

Living specimen examined. Norway, Akershus, Nannestad, N of Gardermoen, on deciduous wood. 1978-09-27. Hermansen & Hjortstam. Hjm 10149.

Remarks. Easily recognized species thanks to its dense hymenial layer, strongly encrusted cystidia, and small suballantoid spores.

SUBULICIUM Hjortst. & Ryv. nov. gen.

Fructificatio resupinata, effusa, adnata, aliquentum inconspicua, tenui, colore pro parte maxima albido; hymenio piloso; cystidiis projectis; margine indeterminato; systemate hyphali monomitico, hyphis distinctis, tenuitunicatis, hyalinis, passim vel numquam incrustatis, non fibulatis; cystidiis lateralis, bi-radicatis, projectis, plus minusve laevibus, crassitunicatis, non-amyloideis, interdum gloeocystidiis vel basidioliis praesentibus; basidiis clavatis vel subcylindraceis, leviter constrictis; sporis tenuitunicatis vel crassiusculis, non-amyloideis, infirme cyanophilis.

Typus generis: Peniophora lauta Jacks.

Fruitbody resupinate, effuse, adnate, usually thin, in colour whitish, hymenium pilose by projecting cystidia. Hyphal system monomitic, hyphae distinct and with thin to thickened walls, sometimes encrusted without clamps. Cystidia lateral, smooth or with encrustations, the wall rather thick, non-amyloid. Gloeocystidia or basidioles with negative reaction to sulfovanilline sometimes present. Basidia clavate or subcylindric, more or less constricted, with four sterigmata. Spores with thin to slightly thickened walls, non-amyloid, not or slightly cyanophilous.

Remarks. Subulicium is a new genus intended for species with thick-walled, non-amyloid, lateral cystidia. The hyphae are clampless and spores generally globose to subglobose or ellipsoid, with thin to somewhat thickened walls. The genus is close to Subulicystidium and the main difference is the lateral cystidia. S. lautum may remind also of Hyphoderma but in this genus the spores are characteristically oil-filled and the basidia are more or less suburniform. Even if in Hyphoderma there are species without

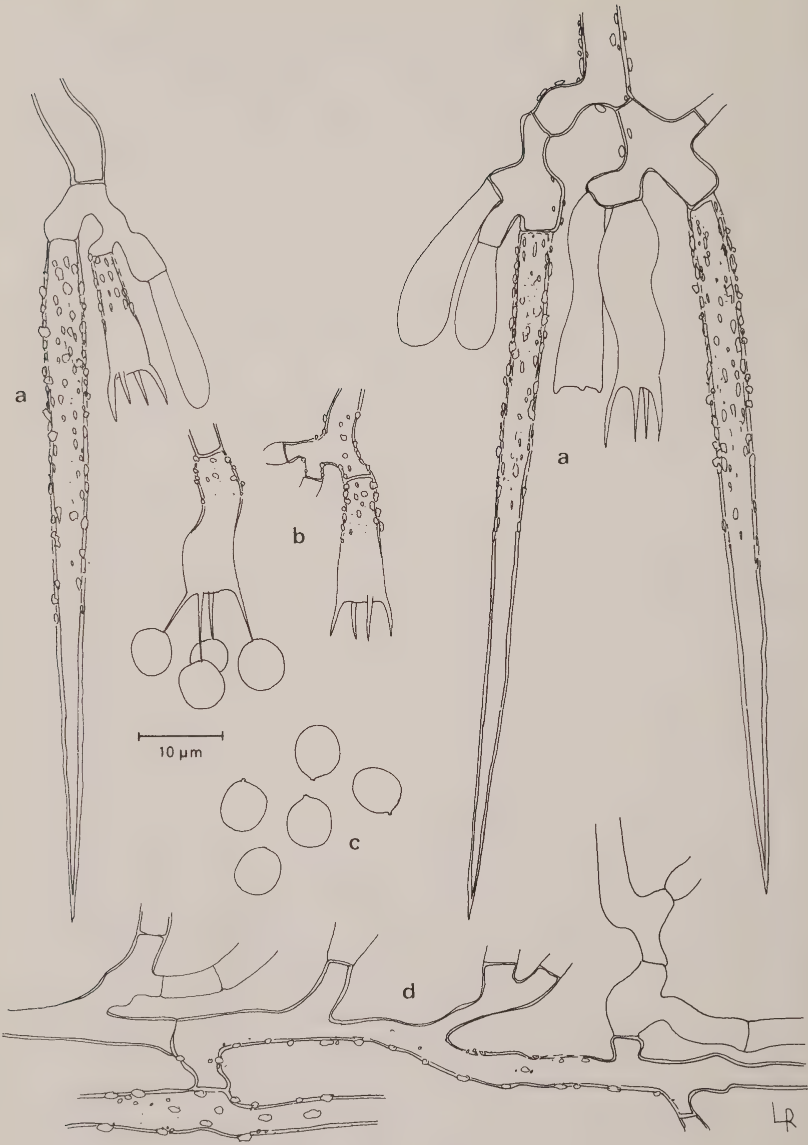

Fig. 4. *Subulicystidium rallum* a) parts of the hymenium with cystidia and basidia b) basidia c) spores d) hyphae from the subiculum. Coll. Jackson 10789.

clamps and also one species, *H. deserticola* Gilb. & Linds. (= *H. luridum* (Bourd. & Galz.) Erikss. & Hjortst.) in which lateral cystidia occur, we do not find it possible to include also *S. lautum* in it.

SUBULICIUM LAUTUM (Jacks.) Hjortst. & Ryv. nov. comb.

Basionym: *Peniophora lauta* Jacks. Can. Journ. Res. C, 26, 129-132, 1948.

Fruitbody resupinate, effuse, adnate, whitish, when young inconspicuous, with age much like species such as *Litschauerella*, *Tubulixenasma* and *Subulicystidium* ssp. through its pilose appearance by projecting cystidia; margin indeterminable. Hyphal system monomitic, hyphae distinct and not or very slightly encrusted, thin-walled, without clamps and about 3-3.5 (-4) um wide. Cystidia projecting and subulate with thickened walls, not or slightly encrusted, distinctly bi-rooted (laterocystidia), in some cases mucronate towards the apex, about 90-120 um long. Besides, but not always occurring, gloeocystidie-like organs also present. They seem to be most easily observed in well-developed specimens and are obtuse, thin-walled, constricted or sinuous, in most cases 30-60 x 5-6 um. Negative reaction in Melzer and in sulfovanilline. Basidia clavate to subcylindrical, thin-walled, constricted, with four sterigmata, about 25-30 x 6 um. Spores globose to subglobose or in some specimens ellipsoid, smooth, thin or becoming thick-walled, 6-7 um in diam., or 6-8 x 4.5-7 um, non-amyloid, with slight cyanophilous reaction.
Habitat. Both on coniferous and deciduous wood, also collected on lumber.

Specimens examined. Canada: Ontario, Don Valley near Sunnybrook Park, Toronto, York Co., on bark of *Thuja occidentalis*. 1942-09-17. Jackson 17581. Type (TRTC): N.E. of Maple York Co., on wood. 1943-10-09. Jackson 18837 (TRTC): do. on barks of *Tsuga canadensis*. 1945-07-15. Jackson 20120. Norway: Akershus, Nannestad, Tömte farm by Hurdal lake, on lumbered wood. 1978-09-18. Hjortstam 9754 (0); Eidsvoll, Mistberget northern slope by Tisjöen (on limestone), on wood in rivulet. 1978-09-26. Hjortstam & Larsson. Hjm 10054 (0). Nordland. Near the airport, Brönnöysund, on *Betula* ? 1976-09-06. Hauerslev 5208. Denmark: Korsör, Taarnborg Park. 1969-06-28. Hauerslev 3395. København, on *Fraxinus excelsior*. 1972-10-07. Hauerslev 4427. Poland: Nawojowa, Rez. Scisly Labowiec, on *Abies alba*, on a trunk lying ab. 20 cm over running water. 1973-09-11. Hallenberg, Hjortstam & Larsson 1982. (GB).

Remarks. Though very characteristic the species is variable, not only with regard to age and growth circumstances. It seems possible to divide it in two forms, judging from shape of spores and presence of "gloeocystidia".

S. lautum is somewhat similar to *Subulicystidium rallum* (see below) but the cystidia in the latter species are terminal and encrusted in a similar way to *S. longisporum* (Pat.) Parm. Moreover, the basidia and hyphae of this species have the same kind of encrustation. These differences make it necessary to place *S. lautum* and *S. rallum* in different genera.

SUBULICYSTIDIUM RALLUM (Jacks.) Hjortst. & Ryv. nov. comb.

Basionym: *Peniophora ralla* Jacks. Can. Journ. Res. C, 136-137, 1948.

Fruitbody resupinate effuse, adnate, whitish, inconspicuous but in some collections welldeveloped, under a lens with projecting cystidia, in outer appearance extremely similar to *Subulicium lautum* and also to e.g. *Litschauerella clematitis* (Bourd. & Galz.) Erikss. & Ryv.

Hyphal system monomitic with the hyphae distinct and thin-walled, heavily encrusted, about 4 um wide, without clamps. Cystidia terminal, subulate to acicular, encrusted, the encrustations both on basidia, cystidia as well on the hyphae dissolving in sulfovanilline, in the same way as in *S. longisporum*. The walls of the cystidia are generally thin but may become thick-walled, about 70 x 4-5 um, sometimes encrusted at the base, in some cases very elongated and up to 40-60 um long, slightly constricted, normally 15-25 x 4.5-6 um. Spores globose to ovoid, 5-6 um in diam., thin-walled, non-amyloid and without cyanophilous reaction.

Habitat. On decayed wood, preferably deciduous trees.

Specimens examined. Canada. Ontario, Lake Timagami, portage to Bull Lake, on *Abies balsamea*. 1936-09-09. R. Biggs 10790. (TRTC). Norway. *Akershus, Baerum, Kjaglia*, on *Alnus* 1977-10-02. Nakken 2186 and 2289. (O). Oppland, Berdöra, in rivulet, on deciduous wood. 1978-08-12. Hjortstam 9618. (O).

Remarks. It is with some uncertainty we place this species in *Subulicystidium*. The cystidia is very similar to those of *S. longisporum* but this species has clamps on the hyphae, while *S. rallum* is simple septate.

The septation of the hyphae is usually looked upon as an important characteristic and many genera are restricted to species with only one type of hyphal septation. However, in *Corticiaceae* there are several genera where both types occur, e.g. *Hyphoderma*, *Hyphodontia*, *Aleurodiscus*, *Gloeocystidiellum*, and *Athelia*, to mention a few. It is obvious that the character of different septation cannot be used for generic delimitation alone. It should be evaluated together with other characteristics.

Jülich (1969) reported that *Subulicystidium longisporum* have basidia with repetition. We have not been able to find any basidial repetition like those of e.g. *Repetobasidium* and *Galzinia*. However, it is usually very difficult to establish the internal basidial repetition, especially in species e.g. *Galzinia incrustans* (Höhn. & Litsch.) Parm., *Hyphodontia crustosa* (Fr.) John Erikss., and *H. pruni* (Lasch) Erikss. & Hjortst., whereas in *Repetobasidium* the repetition is easily recognized.

XENASMA Donk and XENASMATELLA Oberw.

The genus *Xenasma* was erected by Donk (1957:25) with the type species *X. rimicolum* (Karst.) Donk. He also incorporated *Peniophora praeterita* Jacks., *Corticium pruinosum* Pat., and *Corticium pulverulentum* Litsch. The first two species have well differentiated, large cystidia, and also spores which are echinulate (the spines usually dissolving in KOH).

Liberta (1960) made a careful and extensive study of the genus and accepted Donk's concept although he also introduced species with amyloid spores. Oberwinkler (1965) found the genus too widely circumscribed and erected *Xenasmatella* for the acystidiate species, with the type *Corticium flavido-griseum* Litsch. He mentioned besides that species in *Xenasma* had "zylindrisch-langlich (seltner kurz zylindrisch)" basidia while they in *Xenasmatella* were "immer kurz zylindrisch". The latter genus has since been abandoned by Oberwinkler (1977) and the type species was transferred to *Phlebiella* Karst., which is typified by *Phlebia vaga* Fr. The latter species has hitherto been placed in *Trechispora* by Liberta. Parmasto (1968) rejected Oberwinkler's arrangement from 1965 and accepted Donk's genus with the emendation made by Liberta.

As seen below we have also placed one cystidiate species in *Xenasmatella*. We prefer also to describe the new species in this genus even if we are convinced that some species now referred to *Xenasmatella* as well as species in *Phlebiella* and *Trechispora* have rather little in common with one another. Species in these genera need further studies before the generic position can be definitely settled.

XENASMATELLA DECIPIENS Hjortst. & Ryv. nov. spec.

Fructificatio resupinata, effusa, tenuis, sicco plus minusve dura; hymenio cremeo vel ravido, levi; margine sterili nusquam perspicuo; hyphis indistinctis, fibulatis, 2-3 um latis; cystidiis nullis; basidiis plerumque lateralibus, clavatis vel cylindriceis, circiter 20 x 8 um, 4 sterigmatibus; sporis globosis, crassitunicatis, verruculosis, circiter 5-6(-6.5) um diam., non amyloideis.

Holotypus: Spain. Huesca prov., Ordesa Nat. Park, ab. 1500 m, on *Fraxinus excelsior*. 1977-11-09. Ryvarden 14894 (O).

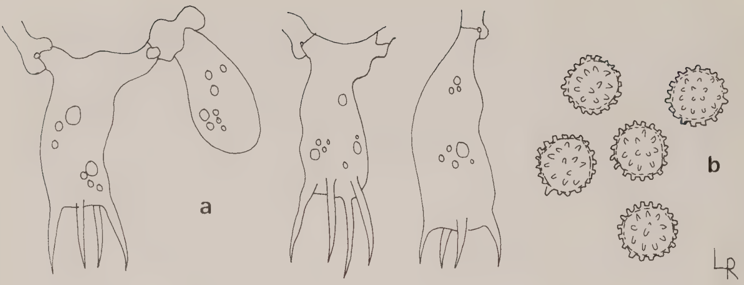

Fig. 5. Xenasmatella decipiens a) basidia b) spores. From the type.

Fruitbody resupinate, effuse, thin to moderately thick, when dry hard, hymenium cream to greyish, when old somewhat ochraceous, in outer appearance much like X. tulasnelloidea; margin indistinct. Hyphal system monomitic with basal hyphae indistinct, subhymenial hyphae about 2-3 um wide, all hyphae with clamps. Cystidia and gloeocystidia lacking. Basidia clavate to cylindrical, in most cases lateral, 20 x 8 um, with four sterigmata. Spores globose, thick-walled, distinctly warted or densely echinulate, 5-6 um in diam., non-amyloid, not dextrinoid.

Habitat. On decayed wood.

Remarks. This is a well distinguished species because of its globose, verruculose spores and lateral basidia. It is separated from X. inopinata in lacking gloeocystidia and by the spores, which in this species are densely echinulate and more reticulated with rounded protuberances. Further, the spores and basidia in X. decipiens are slightly smaller than those of X.inopinata.

Specimen examined. Poland. Bieszczady, at the rivulet Terebowiec 2 km east of Ustrzyki Gome. 1973/09/09. Hallenberg & Larsson 1899. (GB).

XENASMATELLA INOPINATA (Jacks.) Hjortst. & Ryv. nov. comb.

Basionym: Corticium inopinatum Jacks. Can. Journ. Res. C, 28, 718, 1950.

Fruitbody and hyphal system as in X. decipiens. Cystidia or gloeocystidielike organs, tubular or in some cases more or less subulate, sometimes with 1-3 apical protuberances, 40-60 x 6-10 um, without sulfovanilline reaction. Basidia with four sterigmata, in most cases lateral, rarely terminal,

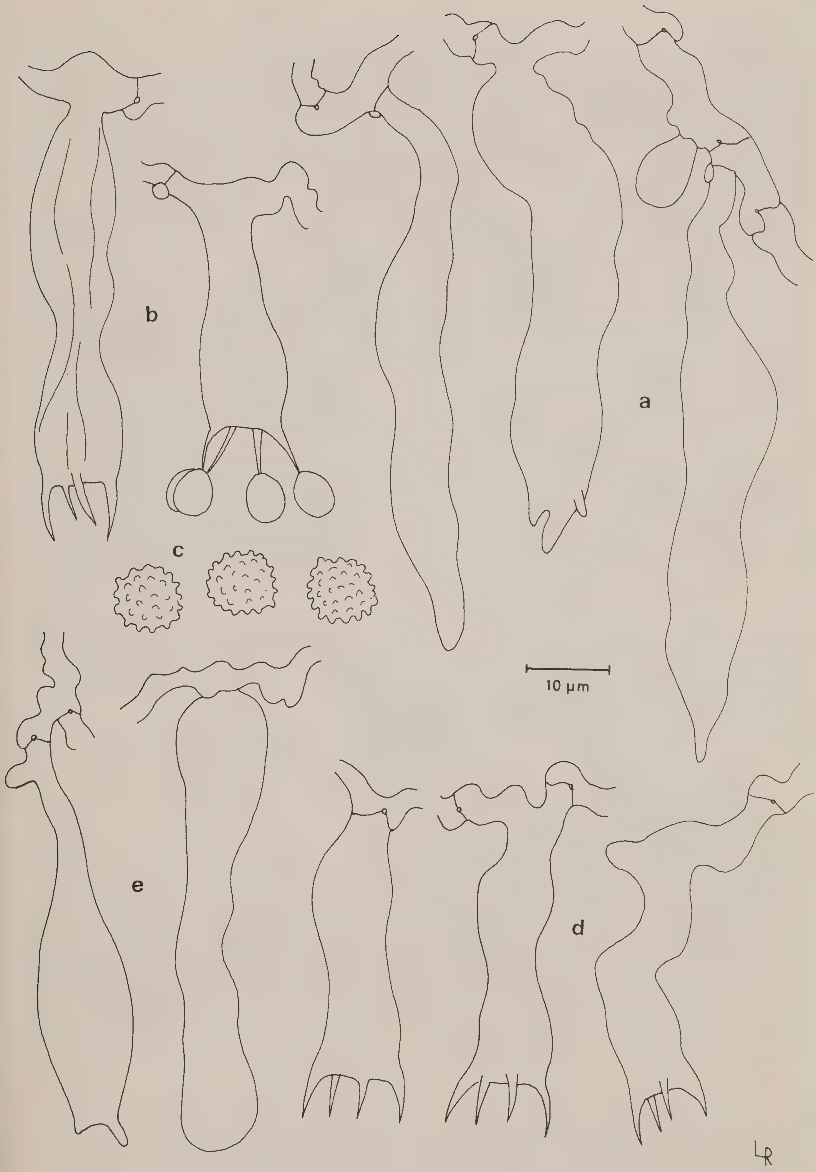
b
a
c
10 µm
e
d
LR

Fig. 6. Xenasmatella inopinata a,e) cystidia b,d) basidia c) spores, a-c, from the type, d-e Jackson 18712.

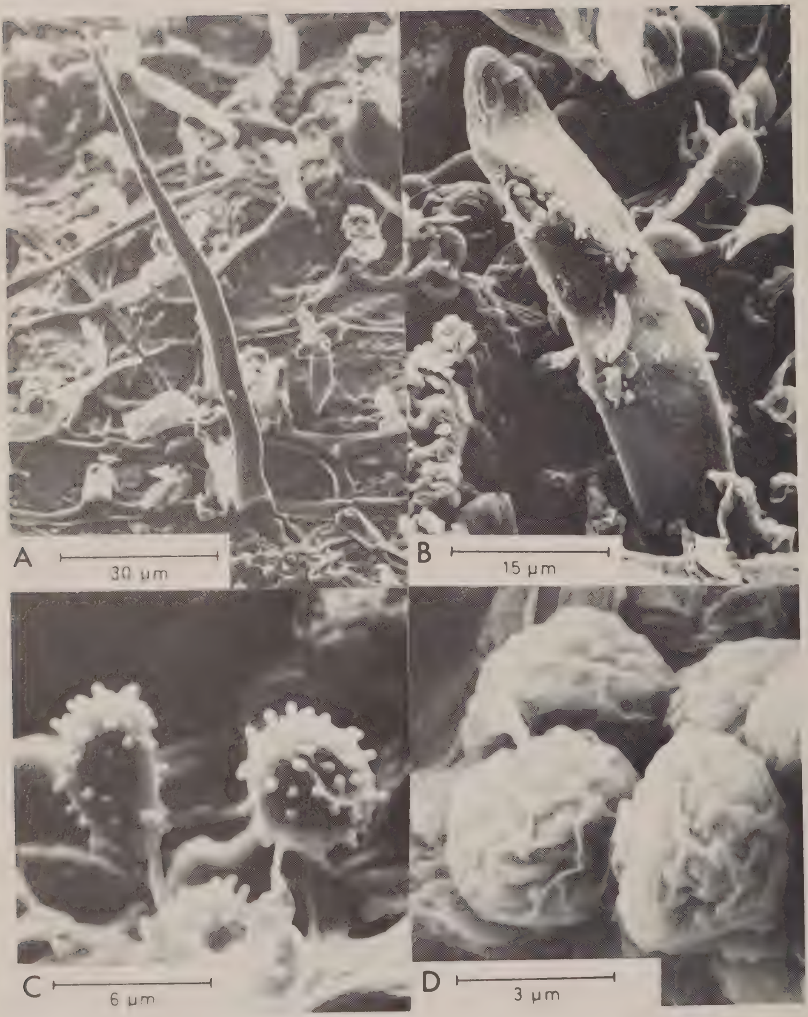
A
30 µm
B
15 µm
C
6 µm
D
3 µm

Fig. 7. A) Subulicium lautum, cystidium B) Phlebia longicystidia, cystidium C) Xenasmatella decipiens, spores D) Xenasmatella inopinata, spores.S.E.M. by Leif Ryvarden.

25-35 x 6-7 um, usually with a weak constriction. Spores globose, 5.5-7.5 um in diam., ornamented, in light microscope when observed in Melzer's and 5% KOH, having rounded warts.

Specimen examined. Canada. Ontario, North Toronto, Strathgowan woods, on wood and bark of *Tsuga canadensis*. 1943-09-17. Jackson 19904 Type (TRTC).

Remarks. During our search for a suitable name for *X. decipiens* we came across *Peniophora inopinata* Jacks. which undoubtedly is closely *related to X. decipiens*. The main differences are the cystidia, and the echinulate spores in *X. inopinata* while they are more verrucose to irregularly ornamented in *X. decipiens* . The species is hitherto not known from Europe.

Acknowledgements.

We are most grateful to Dr. Luella Weresub, Ottawa and Dr. John Eriksson, Göteborg, for valuable help and suggestions. Furthermore, the curators of the herbaria in Ottawa, Toronto, Stockholm, Kew and Helsinki are sincerely thanked for their assistance in sending us collections for examination.

REFERENCES

Donk, M. A. 1957: Notes on resupinate hymenomycetes IV. Fungus 27: 1-29.

Eriksson, J. & Ryvarden, L. 1973-76: Corticiaceae of North Europe 2-4. Oslo.

Hagström, E. 1978: Gloeocystidiellum porosum (Berk. & Curt.) Donk, Göteborgs Svampklubb Årsskrift, 52-56.

Höhnel, F. & Litschauer, V. 1908: Österreichische Corticieen, in Linsbauer, K. (ed): Wiesner Festschrift. Wien.

Jülich, W. 1969: Über die Gattungen Piloderma gen. nov. und Subulicystidium Parm. Ber. Dtsch. Bot. Ges. Bd. 81; 414-421.

Liberta, A. E. 1960: A taxonomic analysis of section Athele of the genus Corticium. I. Genus Xenasma. Mycologia 52: 884-914.

Oberwinkler, F. 1965: Primitive Basidiomyceten. Sydowia 19: 1-72.

Parmasto, E. 1968: Conspectus systematis corticiacearum. Tartu.

Strid, Å. 1975: Wood-inhabiting fungi of Alder Forests .... Wahlenbergia Vol. 1: 1-237.

Weresub, L. K. 1961: Typification and synonomy of Peniophora species sect. Tubuliferae (Corticiaceae) Can. Journ. Bot. 39: 1453-1495.

MYCOTAXON

Vol. IX, No. 2, p. 520 July-September 1979

NOTICE

MYCOLOGICAL NOMENCLATURE - FOSSIL FUNGI

The Nomenclature Secretariat of the International Mycological Association appoints subcommittees of interested persons to examine the problems in the application of the International Code of Botanical Nomenclature to fungi (including lichens). Several such subcommittees have already completed their deliberations and their reports are due to appear in TAXON shortly.

A proposal has been made to the Secretariat that the 'Nomenclature of fossil fungi' is urgently in need of review. The Secretariat is, therefore, prepared to create a subcommittee to this effect and requests all persons active in, or interested in, the fossil fungi to notify the Chairman of their willingness to serve on the subcommittee so that they may be appointed as members. As many interested persons as possible are urged to serve on this subcommittee to ensure that its deliberations may be as comprehensive and detailed as possible.

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MYCOTAXON

Vol. IX, No. 2, pp. 521-522 July-September 1979

LATER STARTING POINT BLUES. I. MONILIA FRUCTIGENA

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Many mycologists believe that we must "learn to live with" the provisions of later starting points for various groups of fungi. For the *fungi caeteri* the starting point date was set as 1.i.1821 by the 1950 International Botanical Congress at Stockholm.

Some of us who worked actively on the International Mycological Association's Nomenclature Subcommittee dealing with later starting points remain convinced that what later starting points primarily encourage is wasted hours trying to check wholly irrelevant references. Kohn's (1979) publication on *Sclerotinia* provides a fine example, which we borrow here.

Correct author citation for the conidial state (anamorph) of the European brown-rot fungus, *Monilinia fructigena* Honey, is the subject under review. Though it was early called *Monilia fructigena* (Pers.) Pers., that author citation is not acceptable under the International Code of Botanical Nomenclature, since both the basionym, *Torula fructigena* Pers., and the transfer to *Monilia* occurred before 1.i.1821. After endless days of library work, and with particular thanks to J. Leland Crane, the following partial synonymy has been evolved for the brown-rot anamorph:

[*Torula fructigena* Pers., Ann. Bot. (Usteri) 15: 26. 1795, pre-starting point, devalidated by ICBN Art. 13.1(f).]
≡ [*Monilia fructigena* (Pers.) Pers., Syn. meth. fung. p. 693. 1801, pre-starting point, devalidated by Art. 13.1(f).]
≡ [*Oidium fructigenum* (Pers.) Schm. *in* Kunze & Schmidt, Mykol. Hefte 1: 80. 1817, pre-starting point, devalidated by Art. 13.1(f).]
≡ [*Oidium fructigenum* (Pers.) *ex ?* Ehrenb., Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 10: 193. 1820? 1821?, *probably* pre-starting point, and if so, devalidated by Art. 13.1(f).]
≡ *Acrosporium fructigenum* (Pers.) *ex* Pers., Mycol. eur. 1: 24. before 28.iii.1822.
≡ *MONILIA FRUCTIGENA* (Pers. *ex* Pers.) Eaton, Man. bot., ed. 3, p. 357. 23.iii-23.iv.1822 (misspelled "Monila").

Despite a voluminous current literature on *Monilia fructigena*, not a single mycologist or a single phytopathologist has ever cited the authorities for the species (correctly) this way, so far as we have been able to determine.

Though 29 years have elapsed since the starting point *date* was established in 1950, no mycologist or pathologist has been able to use our supposedly "precise and simple system of nomenclature" (ICBN, Preamble).

Petersen (1975-*ff*) attempted to catalogue the epithets used in the year 1821 alone, in a valiant effort to make the provisions of Art. 13.1(f) less arduous. Unfortunately, if we follow Petersen, we might cite the authors as "(Pers. *ex* Ehrenb.) Eaton," since Petersen (1975a) thought that Ehrenberg's opus was published in 1821. Later evidence from D. P. Rogers, credited by Petersen (1976a), almost certainly shows it to be pre-1821, though Petersen concluded "may be pre-1821." Though we are confident that most of Petersen's data can be accepted as correct, we do note that the page citation to *Oidium fructigenum* in Ehrenberg given by Petersen (1976a), "ENA: 195," is two pages off.

The dating of articles and books within 1822 is as much of a problem as it was for Petersen for 1821. Many years ago D. P. Rogers gave the senior author a most valuable listing of early books. It gives the date of Persoon's *Mycologia europaea* vol. 1 as "before 28.iii.1822." None of the scores of other journal articles and books that we have examined that appeared between 1.i.1821 and 28.iii.1822 take up the epithet "fructigenum" for the brown-rot anamorph, and Petersen (1976a) found none for 1821, except the Ehrenberg reference above. We thus *hope* we are correct in citing the name as "(Pers. *ex* Pers.)." According to Stafleu and Cowan (1976), the 3rd edition of Eaton's *A manual of Botany for the Northern States* appeared between 23.iii and 23.iv.1822, which would then probably be post-Persoon. Hence Eaton becomes the new combining author under the later starting point rules (21 years after Persoon made the same combination himself).

One can find the "sanctioning" (and of course a post-starting point) use of this epithet in Fries, *Systema mycologicum* 3(2): 430. 1832, where this species is treated as *Oidium fructigenum*. That name — in its post-starting point form — has intentionally *not* been entered into the above synonymy: without yet another diligent search through the literature between 1822 and 1832 we cannot confidently cite its authors correctly. That search we do not intend to make.

No, we cannot "learn to live with" later starting points if we are ever to get out of the dingy recesses of the library. The provisions *must* be changed.

REFERENCES CITED

KOHN, L.M. 1979. A monographic revision of the genus *Sclerotinia*. Mycotaxon 9: 365-444.

PETERSEN, R.H. 1975a. Specific and infraspecific names for fungi used in 1821. Part I. Introduction, A & B. Mycotaxon 1: 149-188.

_____. 1975b. *Ibid.*, Part II. C, and supplement to Part I. Mycotaxon 2: 151-165.

_____. 1976a. *Ibid.*, Part III. D-G. Mycotaxon 3: 239-260.

_____. 1976b. *Ibid.*, IV. H-M. Mycotaxon 4: 185-210.

_____. 1977. *Ibid.*, V. N-Z. Mycotaxon 6: 78-126.

STAFLEU, F.A. & R.S. COWAN. 1976. *Taxonomic literature*, vol. 1: A-G. Ed. 2. Regnum Vegetabile 94: 1-1136.

AUTHOR INDEX, VOLUME NINE

AGERER, R. A new combination in the genus *Flagelloscypha* and a contribution to the identity of *Cyphella peckii* 464-468
BARR, MARGARET E. On the Massariaceae in North America 17-37
BARROWS, CHARLES, *see* PATRICK & BARROWS
BIGELOW, HOWARD E. Notes on *Fayodia* ss. lato 38-47
DANIELSON, R. M. Hypogeous ascomycetes in Alberta, Canada with two new North American records 445-450
DURRIEU, GUY. Urédinales nouvelles de l'Himalaya 482-492
ESCOBAR, GUSTAVO A., *see* McCABE & ESCOBAR
ESCOBAR, GUSTAVO A. & DENNIS E. McCABE. *Limnoperdon*, a cyphellaceous fungus with gasteroid basidia? 48-50
GILBERTSON, R. L. The genus *Phellinus* (Aphyllophorales: Hymenochaetaceae) in western North America 51-89
GOTELLI, DAVID. Synaptonemal complexes in the gametangia of *Sapromyces androgynus* (Leptomitales, Oomycetes) 90-92
GRUND, DARRYL W. New and interesting taxa of *Russula* Pers. *ex* S.F. Gray occurring in Washington State 93-113
HEBLACK, RUSSELL K., *see* STEWART & HEBLACK
HJORTSTAM, KURT & LEIF RYVARDEN. Notes on Corticiaceae (Basidiomycetes) IV 505-519
HOSFORD, DAVID RAMON. Daniel E. Stuntz - A distinguished professor and friend 3-16
HOSFORD, DAVID R., *see* OLIVER & HOSFORD
KOHN, LINDA M. A monographic revision of the genus *Sclerotinia* 365-444
KOHN, LINDA M., *see* KORF & KOHN
KORF, RICHARD P. & LINDA M. KOHN. Later starting point blues. I. *Monilia fructigena* 521-522
LARGENT, DAVID L. Neotype selection for *Agaricus asprellus* 114-116
LARGENT, DAVID L. The contributors and Daniel Stuntz 243
LENNOX, JOANNE WILLIAMS. Collybioid genera in the Pacific Northwest 117-231
LIBONATI-BARNES, SUSAN D. *Filoboletus propullans*, a new poroid agaric from Panamá 232-238
MARR, CURRIE D. Laccase and tyrosinase oxidation of spot test reagents 244-276
McCABE, DENNIS E., *see* ESCOBAR & McCABE
McCABE, DENNIS E. & GUSTAVO A. ESCOBAR. *Chrysoconia*, a gasteroid member of the Coniophoraceae 239-242
MORGAN-JONES, G., *see* SINCLAIR & MORGAN-JONES
OLIVER, DENNIS M. & DAVID R. HOSFORD. Two new species and new records of *Tulostoma* from the Pacific Northwest 277-284
PATRICK, W. W., JR. & CHARLES BARROWS. Western fungi: a New Mexico *Psathyrella* in the *Cystidiosae* of subgenus *Homophron* 493-500
PETERSEN, RONALD H. Notes on mycological history. I. M.A. Curtis vs. a national herbarium 459-463
PFISTER, DONALD H. Type studies in the genus *Peziza*. VIII-X. Species described by G. Massee, E.K. Cash, and F.J. Seaver 501-504
RYVARDEN, LEIF, *see* HJORTSTAM & RYVARDEN
SINCLAIR, R. C. & G. MORGAN-JONES. Notes on hyphomycetes. XXXII. Five new aquatic species 469-481
SMITH, ALEXANDER H. The stirps *Cohaerens* of *Marasmius* 341-347
STEWART, ELWIN L. & RUSSELL K. HEBLACK. Hypogeous fungi of Minnesota: *Genea anthracina* sp. nov. 451-458
THIERS, HARRY D. The genus *Suillus* in the western United States 285-296

TRAPPE, JAMES M. The orders, families, and genera of hypogeous Ascomycotina (truffles and their relatives) 297-340
VAN DE BOGART, FRED. The sections of *Coprinus* present in the western United States 348-357

ERRATA, VOLUME SEVEN

Page 147, lines 15, 31, 34, 41: *for* TFMC *read* TFC
148, line 10: *for* TFMC *read* TFC
482, lines 25, 30: *for* TFMC *read* TFC
491, lines 6, 24: *for* TFMC *read* TFC

ERRATA, VOLUME EIGHT

Page 323, line 2: *for* ITALY *read* SWITZERLAND
327, line 37: for *Italy* read *Switzerland*
430, line 41: *for* defunked *read* defunct
503, line 5: *for* Italy *read* Switzerland
521, line 20: for *Calonectroa* read *Calonectria*
563, line 53: *for* No. 2: *read* No. 3:

ERRATA, VOLUME NINE

Page 482, line 7: for *Coleoporium* read *Coleosporium*
line 9: for *heracleinepalensis* read *heraclei-nepalensis*

REVIEWERS

The Co-Editors and Guest Editors express their appreciation to the following individuals who have reviewed one or more of the papers in this volume prior to publication.

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PUBLICATION DATES FOR MYCOTAXON

Volume 8, No. 2: April 21, 1979
Volume 9, No. 1: June 12, 1979

INDEX TO FUNGOUS AND LICHEN TAXA, VOLUME NINE

This index includes genera, infrageneric taxa, species, and infraspecific taxa. New taxa are in CAPITALS, and the pages where they are published are in *italics*. New suprageneric taxa are in *ITALIC CAPITALS*. The special "Stuntz Festschrift" number is separately indexed (pp. 358-364), as also is Kohn's monographic treatment of *Sclerotinia* (pp. 442-444); references to these indices are indicated by the notation "*see*."

Acrocordia 34
Acrosporium fructigenum 408, 521
Agalospora *see* 358
Agaricus *see 358;* butyraceus 219; cirrhatus 193; extuberans 222; maculatus v scorzonerus 214; racemosus 191; tuberosus 197
Aldrigea 509
Aleurina aquehongensis 503; stipitata 502, 503
Aleurodiscus 514
Amanita *see* 358
Amphisphaeria *see* 358; pelospora 34
Amphobotrys ricini 425
Amylascus *see* 358
Anguillospora 476, 477
Armillaria 119
Ascoscleroderma *see* 358
Asteromassaria 27
Asterostomella 21
Athelia 514

Baeospora *see* 358
Balsamia *see* 358
Barlaea subaurantiaca 502
Barssia *see* 358; YEZO-MONTANA 297, 323, *336*
Boletus *see* 358
Botryotinia *see* 442
Botrytis *see* 442

Calyptella faginea 466
Callistosporium *see* 358; GRAMINICOLOR 148, 150, *152*
Calvatia 253
Cantharellula subg Neocantharellula 157
Cantharellus *see* 358
Carbomyces *see* 358
Caryospora *see* 358
Caulocarpa 316
CAULORHIZA 117, 125, 128, 129, 131, *154;* UMBONATA 150, *154*, 155
Chaetocypha parasitica 464
Choiromyces *see* 358; ABORIGINUM 297, 320, *334*, 335
CHRYSOCONIA 239, *240;* ORTHOSPORA 239, *240*, 241
Ciboria *see* 442
Ciborinia *see* 442; CAMELLIAE 375, *399*
Cladosphaeria *see* 359
Clavulina cristata 253
Clavulinopsis fusiformis 253
CLELANDIA 317, *331;* ARENACEA 297, 317, *331*
Clitocybe *see* 359
Clitocybula *see* 359
Clitopilopsis 134
Coenococcum 448
Coleosporium 483, 484; cacaliae 483; campanulae 483; miteri 484; NEPALENSE 482, *483*, 484
Collybia *see* 359; stirps Butyracea 218; stirps Maculata 200; cirrhata v cookei 194; maculata v immutabilis 215; v occidentalis 217; olympiana 137; subsulcatipes 201; umbonata 154
Collybidium 170
Coprinus *see* 359; sect SETULOSI 349, 350, *354*, 356; subsect Setulosi 355
Coriolus *see* 359
Corticium flavido-griseum 515; inopinatum 516; pruinosum 515; pulverulentum 515
Cortinarius *see* 359
Crinipellus 120
Cronartium ribicola 482
Cryptoderma leucosperma 19
Cyphella candida 466, 468; faginea 466, 468; parasitica 464; peckii 464, 466-468
Cystoderma 341

Daedalea pini 70
Delastria *see* 359
Delastriopsis phlebodermum 337
Densocarpa 320
Diatrype angulare 26, 27
DINGLEYA 314, 315, *331;* VERRUCOSA 297, 314, *331*, 333
Discinella 502
Dothivalsaria *see* 360
DUMONTINIA 365, 370, 372, 375, 378, *432;* TUBEROSA 375, 376, 383, 413, 430, *432*-434.

Elaphomyces *see* 360, 449, 450; subg ASCOSCLERODERMA 297, 313, *336;* granulatus 449, 450; v granulatus 445, 449; leveillei 445, 447, 448, 450; muricatus 445, 449; v muricatus 449
ELAPHOMYCETALES 297, 312, *330*
Elderia 320, 335
ELLIOTTINIA 365, 377, *415*, 432; KERNERI *415*
Entoloma 252
Epidochium *see* 442

Fayodia *see* 360; ALUTACEA *39*, 41, 46
Flagelloscypha 464, 466, 468; applanata 466; faginea 464, 466-468; flagellata 466; kavinae 464; PARASITICA *464*-467; punctiformis 468; virginea 466
Flammulina *see* 360
Filoboletus *see* 360; PROPULLANS 232, *233*,

236, 237
Fischerula *see* 360
Fomes *see* 360
Fomitoporia prunicola 73; weirii 87
Fuligo 461

Galzinia 515; incrustans 515
Genabea *see* 360, 451
Genea *see* 360, 451, 452, 454; ANTHRACINA 451, *452*-458; gardneri 453; KRASPEDOSTOMA 297, 322, *336;* thaxteri 453, 454
GENEACEAE 297, 324, *330*
Geopora 298, 319; clausa ssp californica 446; ssp clausa 445-447; f clausa 445-447; f ellipsospora 446; cooperi 319; f gilkeyae 445, 446
Geopyxis 321; pocula 393
Gloeocystidiellum 514
Gloeoporus dichrous 253
Gloeosporium 484
Gloeotinia *see* 442
Grifola frondosa 251
Gymnopus *see* 360; trullisatus 179

Halocyphina 49
Hebeloma 138
Helotium sclerotiorum 378, 383
Helvella astieri 313
Hemicollybia 132
Hericium ramosum 252, 254
Heteroscypha 466
Heterosporula 38
Hirneola 134
Hirschioporus pargamenus 253
Hydnobolites *see* 360
Hydnocystis *see* 360
Hydnotrya *see* 360; ellipsospora 336
Hydnotryopsis *see* 360
Hygrophorus *see* 360
Hymenoscypha *see* 442
Hymenoscyphus *see* 442, 502
Hyphoderma 507, 511, 514; argillaceum 507; deserticola 513; INVOLUTUM *505*-507; luridum 513
Hyphodontia 514; crustosa 515; pruni 515
Hypholoma capnoides 254
Hypochnella 509
Hypomyces lactifluorum 252
Hypsizygus marmoreus 253

Inocybe *see* 360
Inonotus glomeratus 63
Ischnoderma resinosum 253

Jaapia 241
Jafnea fusicarpa 501
Julella luzonensis 32

Labyrinthomyces *see* 361; VARIUS 297, 308, 320, *336*
Laccaria ochropurpurea 254
Lachnea tomentosa 502
Lachnella 464; filicina 468; parasitica 464
Lactarius *see* 361
Lactocollybia 121
Laetiporus sulphureus 254
Lambertella *see* 442
Lanzia *see* 442
Lemonniera 471; ALABAMENSIS *469*-472; centrosphaera 471; pseudofloscula 471, 472
Lepista 43, 135, 136
Leptonia *see* 361
Leptosphaeria *see* 361
Leptosphaerulina 20
Lespiaultinia 328, 329
Limnoperdon *see* 361
Litschaurella 513; clematidis 514
Lophiostoma macrosporum 33
Lyophyllum *see* 361

Macroscyphus tuberosus 430
Marasmius *see* 361; LEIGHII 343, *344*, 346
Martininia 377
Massaria *see* 361
Massariella xanthoxyli 30
Massariovalsa *see* 361
Melampsora ribesii-epitaea 482; RIBIS *482*
Melanoleuca 43
Melanomma sulcata 24
Merisma 461
Merulius tremellosus 253
Metulodontia 509; cremeo-alutacea 509; nivea 509; queletii 509; roumegueri 509
MICROCOLLYBIA 117, 121, 124-127, 132, *187*, 190; CIRRHATA 188, 190, 192, *193*, 196, 198; COOKEI 188, 190, *194*, 195, 196; RACEMOSA 188, 190, *191*, 192; TUBEROSA 187, 188, 190, 195, *196*
Microstoma *see* 442
Mitrula sclerotiorum 378
Moellerodiscus 399, 413
Monilia *see* 442; fructigena 521, 522
Monilinia *see* 443; fructigena 521
Mucidula 119
Mucronoporus everhartii 60
Mukagomyces *see* 361; hiromichii 336
Mycena *see* 361
Mycenella 43
Mycocentrospora 474, 476, 477; acerina 474; angulata 474; aquatica 474, 476; clavata 474; filiformis 474, 476; VARIANS 469, *472*-474, 476
Myrioconium *see* 443
Myriosclerotinia *see* 443
Myrmaecium megalosporum 26
Myrmecocystis 451
Myxocollybia 120, 170
Myxomphalia *see* 361

Nothojafnea 503; cryptotricha 503; thaxteri 503

Obstipispora 469; chewaclensis 469
Octospora tuberosa 429, 430
Oidium fructigenum 521, 522; laxum 416
Omphaliaster 43
Omphalina striatula 42
Ostreichnion *see* 361
Oudemansiella *see* 361
Ovularia 417, 425
Ovulinia *see* 443

Pachyella adnata 504
Pachyphloeus *see* 361
Panellus *see* 361
Paradoxa *see* 361
Parmentaria astroidea 27
Paurocotylis *see* 361
Peltigera 42
Peniophora subg Scopuloides 509; sect Scopuloides 509; hydnoides 509; inopinata 519; involuta 505; lauta 505, 511, 513; longicystidia 507; praeterita 515; ralla 514
Perenniporia subacida 254
Petchiomyces *see* 362; kraspedostoma 336
Peziza *see* 362, *see* 443, 501-504; alaskana 502; atrovinosa 502; badia 502, 503; brunneo-atra 502; concentrica 503; ELLIPSOSPORA 297, 308, 314, 316, *336;* kerneri 414, 415; martialis 501; melaleucoides 503, 504; morgani 501; nana 501; ostracoderma 503; plicata 502; pseudoclypeata 504; retiderma 502, 503; retispora 502; saccardoiana 502; STUNTZII 297, 316, 333, *335;* subaurantiaca 502; thaxteri 503; tomentosa 502; tuberosa 429-432; vesiculosa 503; waltersii 504
Phaeocollybia kauffmannii 156
Phaeoscherotinia 422
Phaeosclerotinia *see* 443
Phellinus *see* 362; PRUNICOLA 51, 53, *73*, 75; SONORAE 51, 53, *77*-79
Phialea *see* 443
Phillipsia 501, 502; minor 501
Phlebia 507, 509; LONGICYSTIDIA 505, *507*, 508, 518; vaga 515
Phlebiella 515
Pholiota *see* 362
Phoma 27
Phylloporia 76
Phymatomyces *see* 362; yezo-montanus 297, 323, 336
Picoa *see* 362
Piersonia 301
Platystomum macrosporum 33
Pleamphisphaeria *see* 362
Pleospora 32
Pleuropus roseiavellaneous 140
Pleurotus ostreatus 253
Pluteospora 134
Poculum 408, 418, 428
Polyporus *see* 362
Poria *see* 362
Poromycena 232
Psathyrella 493, 494, 499; subg Homophron 493, 499; subg Pannucia 499; sect Cystidiosae 493, 499; sect Homophron 495; sect Pannucia 495; stirps Minutisperma 499; ACULEATA 493, *495*, 499, 500; carbonicola 495, 499; pennata 499; solitaria 499; stuntzii 495, 499, 500
Pseudoanguillospora 476, 477; GRACILIS 469, *474*, 475, 477; stricta 477
Pseudobalsamia 323
Pseudohiatula 121, 174
Pseudohydnum gelatinosum 255
Pseudovalsa *see* 362
Pseudovalsaria occulta 29
Puccinia 484, 487, 489; ANNAPURNAE 482, 490, *491;* atragenicola 487; caricis 488; clavata 487; COMMELINAE 482, *484*, 486; corteyi 491; heraclei 489; heracleicola 491; HERACLEI-NEPALENSIS 482, *489*, 490; MALLAE 482, *485*, 486; MANANGENSIS 482, 486, *487;* nitidula 491; PILEARUM 482, 486, *488;* sibirica 491; urticae 488; wattiana 485-487
Pycnopeziza 377
Pyramidospora casuarinae 479; constricta 479; densa 479; fluminea 479; herculiformis 479; ramificata 479; STELLATA 469, *477*-479
Pyrenophora 20
Pyropolyporus *see* 362
Pythium 90

Ramaria *see* 362
Repetobasidium 515
Rhacodiella *see* 443
Rhizopogon rubescens 449
Rhodoarrhenia *see* 362
Rhodocollybia *see* 362-363; sect BUTYRACEA 200, *218;* sect MACULATA *200;* BADIIALBA 219, 222, *224*, 227; BUTYRACEA 218, *219*-222; EXTUBERANS 218, *222*, 224, 225, 228; maculata v FULVA 201, *210;* 212; v IMMUTABILIS 201, *215;* v NIGRA 201, 208, *211;* v. OCCIDENTALIS 201, 212, 216, *217;* v SCORZONERIA 201, *214*, 216; OREGONENSIS 126, 200, *202*, 205, 206; SUBNIGRA 201, *205*, 212; SUBSULCATIPES 200, *201*, 202
Rhodocybe *see* 363; sect ECHINOSPORAE *136;* OLYMPIANA 127, *137*, 142; striatula 42
Rhodopaxillus nitellinus 139
Rhodophyllus 135
Russula *see* 363; rosacea v MACROPSEUDOCYSTIDIATA 93, *101*, 104, 112; STUNTZII 93, *97*, 99-101; VIRIDOFUSCA 93, *94*, 96, 97, 108
Rutstroemia *see* 443

Saccothecium 27
Sapromyces, *see* 363
Sarcoscypha protracta 369
Sarcosphaera *see* 363
Scleroderma 313
Scleromitrula *see* 443
Sclerotinia *see* 443-444
Sclerotiopsis *see* 444
Sclerotium *see* 444
SCOPULOIDES 505, *509;* HYDNOIDES 505, *509*
Seaverinia geranii 410
Septoria culmifida 404
Septotinia *see* 444
Sphaeria *see* 363
Sphaerosoma *see* 363
Sphaerozone *see* 363
Splanchnonema 27
STACHYOMPHALINA 39, *41*, 43; STRIATULA 41, *42*-45
Stephensia *see* 363

Strobilurus *see* 363; TRULLISATUS 172, 176-*179*, 183
Stromatinia *see* 444
Stropharia ambigua 254
SUBULICIUM 505, *511;* LAUTUM 505, 510, 511, *513*, 514, 518
Subulicystidium 511, 513, 514; longisporum 514, 515; RALLUM 505, 512, *514*
Suillus *see* 363-364

Terfezia *see* 364; oligosperma 336
Tirmania *see* 364 ('Trimania')
Titanella *see* 364; MACROSPORA 30, 32, *33*, 34; PELOROSPORA 30, 32, *34*
Torula fructigena 408, 521
Trametes *see* 364
Trechispora 32, 515
Trematosphaeria *see* 364
Tricholoma *see* 364
Trichophaea 319
Tripospermum 481; camelopardus 481; myrti 481; PROLONGATUM 469, *479*-481
Tuber *see* 364; HIROMICHII 297, *336;* OLIGOSPERMUM 297, *336;* PHLEBODERMUM 297, *337*
Tubulixenasma 513
Tulostoma *see* 364; FERRUGINEUM 277, *279*, 280, 282; STUNTZII 277, *278*, 282
Typhula 421, 426
Tyromyces *see* 364

Uredo pileae 488
Urnula hartii 412
Uromyces commelinae 484

Valsa profusa 364
Valsaria *see* 364
Verpatinia *see* 444
Verrucobotrys geranii 410

Wettsteinina 20
Whetzeliana sclerotiorum 379
Whetzelinia *see* 444

Xenasma 515; rimicolum 515
Xenasmatella 515; DECIPIENS 505, *515*, 516, 518, 519; INOPINATA 505, *516*-519; tulasnelloidea 516
Xerula 20

Zopfia *see* 364

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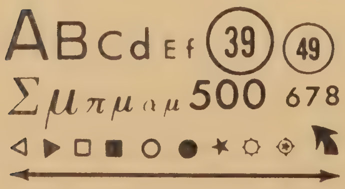

MYCOTAXON

VOLUME X, 1979-1980

COMPLETE IN TWO QUARTERLY ISSUES
CONSISTING OF iv + 524 PAGES
INCLUDING FIGURES

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Published by
MYCOTAXON, LTD., P.O. BOX 264, ITHACA, NY 14850, USA
Printed in the United States of America

TABLE OF CONTENTS, VOLUME TEN

No. 1 October-December 1979

Annotated, illustrated, host index of Sonoran Desert rust fungi, GEORGE B. CUMMINS.......... 1
Comparative ascospore morphology of certain strains of *Rollandina* by scanning electron microscopy, GOURI RANI GHOSH, G. F. ORR, A. C. PIER & J. E. GALLAGHER.......... 21
Comparative physiology of some strains of *Rollandina*, RATNAKAR MOHANTY & GOURI RANI GHOSH.......... 29
Notes on mycological history. II. Some disbursements of Schweinitz's fungi, RONALD H. PETERSEN.......... 37
Rhytidospora and *Pteridiosperma*, gen. nov. (Melanosporaceae), J. C. KRUG & R. S. JENG.......... 41
Physalacria subpeltata sp. nov. from Hawaii, SCOTT A. REDHEAD...... 46
Indexes to W. G. Solheim's Mycoflora Saximontanensis Exsiccata, R. L. GILBERTSON, G. B. CUMMINS & ELIZABETH D. DARNALL.......... 49
Conidium ontogeny and morphology of *Cercospora kikuchii*, C.-C. YEH & J. B. SINCLAIR.......... 93
Complexipes moniliformis: a new genus and species tentatively placed in the Endogonaceae, CHRISTOPHER WALKER.......... 99
Fungi of the Gulf Coast I. Two new species of *Hygrophorus* section *Hygrocybe*, WILLIAM G. CIBULA.......... 105
Mucilopilus, a new genus of the Boletaceae, with emphasis on North American taxa, CARL B. WOLFE, JR. 116
Renispora flavissima, a new Gymnoascaceous fungus with tuberculate *Chrysosporium* conidia, L. SIGLER, P. K. GAUR, R. W. LICHTWARDT & J. W. CARMICHAEL.......... 133
Comparative morphology and taxonomic disposition of *ebulbosus*, *quadrifidus*, and *variegatus* in the genus *Coprinus* (Agaricales), W. W. PATRICK, JR. 142
The genus *Coprinus* in western North America, Part III: Section *Atramentarii*, FRED VAN DE BOGART.......... 155
A study of *Amanita* types III. Taxa described by W. A. Murrill, DAVID T. JENKINS.......... 175
Notes on Corticiaceae (Basidiomycetes) V, KURT HJORTSTAM & LEIF RYVARDEN.......... 201
Studies in the lichen family Physciaceae. V. Two species of *Physcia* new to North America, THEODORE L. ESSLINGER.......... 210
Additions to the Diaporthales, MARGARET E. BARR.......... 213
Kutilakesa pironii sp. nov., a stem gall- and canker-inciting fungus, new to the United States, S. A. ALFIERI, JR. 217
Zoophthora erinacea sp. n. (Zygomycetes: Entomophthoraceae), a fungal parasite of aphids, ISRAEL BEN-ZE'EV & ROBERT G. KENNETH 219
Blistum musae: a new species of synnematal hyphomycete, KEITH A. SEIFERT.......... 233
Phacidiales Exsiccati Decades I-III, MARTHA A. SHERWOOD.......... 241
Pithomyces funiculosa sp. nov. from fungal comb of *Macrotermes ukuzii* in Swaziland, MARY E. PALM, ELWIN L. STEWART & AMY Y. ROSSMAN.......... 246
A new species of *Fennellomyces* (Mucorales), P. C. MISRA, N. N. GUPTA & KANCHAN LATA.......... 251
Three new species of *Claussenomyces* from Macaronesia, G. B. OUELLETTE & RICHARD P. KORF.......... 255

No. 2 January-March 1980

Notes on Corticiaceae (Basidiomycetes) VI. *Rogersella eburnea* nov. spec., KURT HJORTSTAM & EVEN HØGHOLEN....................... 265
Studies in tropical Corticiaceae (Basidiomycetes) I, KURT HJORTSTAM & LEIF RYVARDEN................................ 269
Pocillopycnis, an emendation, FRANK DICOSMO........................ 288
A new genus and a new species of Clathraceae, BO LIU & YUN-SUN BAU. 293
A new species of *Amanita*, DAVID T. JENKINS......................... 296
Notes on Colorado fungi IV: Myxomycetes, D. H. MITCHEL, S. W. CHAPMAN & M. L. FARR.. 299
Validation of *Entomophthora aquatica*, JOHN F. ANDERSON & SANDRA L. ANAGNOSTAKIS... 350
Analysis of the basidium of higher basidiomycetes on the basis of geometrical dependencies, S. P. WASSER & E. G. BERGER............ 351
Absconditella duplicella and *Cryptodiscus rutilus:* additions to the Ostropalean fungi, AMY Y. ROSSMAN.......................... 365
Filamentous fungi associated with leaf surfaces of red alder and Douglas fir seedlings in western Oregon, AMY Y. ROSSMAN & K. C. LU.. 369
Notes on Hyphomycetes.
- XXXIII. *Stachybotrys sphaerospora* sp. nov. from South Africa, G. MORGAN-JONES & ROBERT C. SINCLAIR........................... 372
- XXXIV. Some mycoparasitic species, DENNIS J. GRAY & G. MORGAN-JONES... 375
- XXXV. *Stenellopsis* gen. nov., G. MORGAN-JONES................... 405

Notes on the genus *Subulicystidium*, ANTHONY E. LIBERTA............. 409
Three new endomycorrhizal *Glomus* spp. associated with actinorrhizal shrubs, SHARON L. ROSE & JAMES M. TRAPPE........... 413
Teratosperma oligocladum, a new hyphomycetous mycoparasite on sclerotia of *Sclerotinia sclerotiorum*, *S. trifoliorum*, and *S. minor*, F. A. UECKER, W. A. AYERS & P. B. ADAMS................ 421
The peniophoroid fungi of the West Indies, A. PUNUGU, M. T. DUNN & A. L. WELDEN...................................... 428
Two new species of *Cercospora*, R. C. RAJAK.......................... 455
Mollisia in Macaronesia: an exercise in frustration, MARK A. GREENLEAF & RICHARD P. KORF............................. 459
Cytospora vs. *Cytispora:* which is correct?, LINDA J. SPIELMAN...... 473
Synopsis of wood-rotting fungi on spruce in North America: III, K. J. MARTIN & R. L. GILBERTSON................................ 479
Notices
- Second International Congress of Systematic and Evolutionary Biology.. 502
- XIII International Botanical Congress............................ 502
- Botanical Latin.. 502

Revisionary studies in the Hyaloscypheae. I. On genera with "glassy" hairs, RICHARD P. KORF & LINDA M. KOHN................. 503

Author INDEX.. 513
Reviewers... 515
MYCOTAXON publication dates, 9(2) and 10(1)............................ 515
INDEX to Fungous and Lichen Taxa.. 516
Errata, Volumes 9 and 10.. 524

K
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992
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MYCOTAXON

AN INTERNATIONAL JOURNAL DESIGNED TO EXPEDITE PUBLICATION
OF RESEARCH ON TAXONOMY & NOMENCLATURE OF FUNGI & LICHENS

Volume X October-December 1979 No. 1

CONTENTS

Annotated, illustrated, host index of Sonoran Desert rust fungi. GEORGE B. CUMMINS 1

Comparative ascospore morphology of certain strains of *Rollandina* by scanning electron microscopy. GOURI RANI GHOSH, G. F. ORR, A. C. PIER AND J. E. GALLAGHER 21

Comparative physiology of some strains of *Rollandina*. RATNAKAR MOHANTY AND GOURI RANI GHOSH 29

Notes on mycological history. II. Some disbursements of Schweinitz's fungi. RONALD H. PETERSEN 37

Rhytidospora and *Pteridiosperma*, gen. nov. (Melanosporaceae). J. C. KRUG AND R. S. JENG 41

Physalacria subpeltata sp. nov. from Hawaii.................... SCOTT A. REDHEAD 46

Indexes to W. G. Solheim's Mycoflora Saximontanensis Exsiccata. R. L. GILBERTSON, G. B. CUMMINS AND ELIZABETH D. DARNALL 49

Conidium ontogeny and morphology of *Cercospora kikuchii*. C.-C. YEH AND J. B. SINCLAIR 93

Complexipes moniliformis: a new genus and species tentatively placed in the Endogonaceae.. CHRISTOPHER WALKER 99

Fungi of the Gulf Coast I. Two new species of *Hygrophorus* section *Hygrocybe*. WILLIAM G. CIBULA 105

Mucilopilus, a new genus of the Boletaceae, with emphasis on North American taxa.. CARL B. WOLFE, JR. 116

Renispora flavissima, a new Gymnoascaceous fungus with tuberculate *Chrysosporium* conidia. L. SIGLER, P. K. GAUR, R. W. LICHTWARDT AND J. W. CARMICHAEL 133

Comparative morphology and taxonomic disposition of *ebulbosus*, *quadrifidus*, and *variegatus* in the genus *Coprinus* (Agaricales).......... W. W. PATRICK, JR. 142

The genus *Coprinus* in western North America, Part III: Section *Atramentarii*. FRED VAN DE BOGART 155

A study of *Amanita* types III. Taxa described by W. A. Murrill.. DAVID T. JENKINS 175

Notes on Corticiaceae (Basidiomycetes) V....... KURT HJORTSTAM AND LEIF RYVARDEN 201

Studies in the lichen family Physciaceae. V. Two species of *Physcia* new to North America.................................. THEODORE L. ESSLINGER 210

Additions to the Diaporthales................................. MARGARET E. BARR 213

Kutilakesa pironii sp. nov., a stem gall- and canker-inciting fungus, new to the United States................................. S. A. ALFIERI, JR. 217

Zoophthora erinacea sp. n. (Zygomycetes: Entomophthoraceae), a fungal parasite of aphids.................... ISRAEL BEN-ZE'EV AND ROBERT G. KENNETH 219

Blistum musae: a new species of synnematal hyphomycete......... KEITH A. SEIFERT 233

Phacidiales Exsiccati Decades I-III.......................... MARTHA A. SHERWOOD 241

Pithomyces funiculosa sp. nov. from fungal comb of *Macrotermes ukuzii* in Swaziland............... MARY E. PALM, ELWIN L. STEWART AND AMY Y. ROSSMAN 246

A new species of *Fennellomyces* (Mucorales). P. C. MISRA, N. N. GUPTA AND KANCHAN LATA 251

Three new species of *Claussenomyces* from Macaronesia. G. B. OUELLETTE AND RICHARD P. KORF 255

[MYCOTAXON for July-September 1979 (9: 365-528)
was issued July 13, 1979]

ISSN 0093-4666 MYXNAE 10(1) 1-264 (1979)

Library of Congress Catalogue Card Number 74-7903

Published quarterly by MYCOTAXON, Ltd., P.O. Box 264, Ithaca NY 14850
For subscription details and availability in microform, see back cover

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OCT 3 1979

MYCOTAXON

Vol. X, No. 1, pp. 1-20 October-December 1979

ANNOTATED, ILLUSTRATED, HOST INDEX OF SONORAN DESERT RUST FUNGI[1]

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SUMMARY

Spore dimensions and illustrations are presented for 90 species of Uredinales under an alphabetized arrangement of the genera of host plants. There are 12 species on Gramineae, 21 on Compositae and 21 on Leguminosae; other families have four or fewer. An addendum lists 13 species occasionally reported on cultivars. A status change is *Puccinia grindeliae* Peck ssp. *riddelliae* (Griff.) stat. nov. *(Gymnoconia ridelliae* Griff.) on *Baileya multiradiata* and *Psilostrophe cooperi.*

INTRODUCTION

The Sonoran Desert has an abundant and varied vegetation of herbs, shrubs, and trees. For this reason, much of the area does not correspond to the popular conception of a desert. Shreve and Wiggins (1964) required 1740 pages to describe the vegetation and flora; 193 pages are devoted to a general description of the area and 1548 pages to a taxonomic exposition of the plants. The desert (Shreve and Wiggins, 1964) occupies the southeastern corner of California, southwestern Arizona, most of Baja California except the northwestern section, and most of the western half of Sonora. The elevation is mostly below 3000 ft. The outline of the desert often is irregular, due to extensions into canyons and the intrusion of mountains.

Most of the records of fungi that I have used are in the Arizona Mycological Herbarium. Early collections included a few by Edward Palmer in Sonora and by J. W. Toumey, J. J. Thornber, and David Griffiths in Arizona. Later collectors who accounted for many records were R. B. Streets, L. N. Goodding, and P. D. Keener. From about 1960 onward, G. B. Cummins added both Sonoran and Arizona records and, after 1967, R. L. Gilbertson has been an active collector in Arizona. Many areas, especially Baja California, are largely unknown mycologically, so this index can be only provisional. The numbers of species probably will be subject to limited additions, but distributions and host records will be extended. *Puccinia turgidipes*, for example, in Arizona occurs within five miles of the border but is not recorded in Mexico. Some species, e.g. *Puccinia leptochloae*, occur in Mexico at sea level but Arizona records are above the desert, which is the reverse of the expected distribution.

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[1] University of Arizona Agricultural Experiment Station Journal Article No. 2974.

Because the principal rains come in the latter half of summer, most aecial stages occur in late summer. Exceptions are the rusts of bulbous plants, such as *Allium* and *Dichelostemma*, which develop early in the spring. Dormancy, for most species, involves a long dry period rather than a cold period. Heteroecious species are less common than at higher elevations and more humid areas. When they do occur, both host plants always are intimately associated and lateral spread is minimal. Cyperaceae are not common and this alone reduces the potential for heteroecious rust fungi. Shreve and Wiggins (1964) list only two species of *Carex*. *Puccinia canaliculata* is the only sedge rust in my list. Grasses are more numerous than sedges and composites and legumes are abundant. Disregarding rusts of cultivars, there are 12 species of rust fungi on grasses, 21 species on composites, and 21 on legumes.

Descriptions are limited to little more than spore dimensions in µm; shape, surface, and germ pores are shown in the illustrations. Greater detail is available in Arthur (1907-27, 1934) or, for the rusts of grasses or of composites and legumes, in Cummins (1971, 1978).

HOST INDEX

ABUTILON (Malvaceae)

Puccinia heterospora Berk. & Curt. Fig. 18.
Life cycle microcyclic; spores mostly 1-celled (13-)17-25(-28) long; 2-celled (20-)27-34(-38); brown. Distribution: Arizona and Sonora on *A. californicum* Benth., *A. incanum* (Link) Sweet, *A. sonorae* Gray, *Herissantia crispa* (L.) Briz.

ACACIA (Leguminosae)

Ravenelia cumminsii J. W. Baxt. Fig. 1.
Life cycle unknown. Urediniospores (20-)24-30(-33) x (8-)10-14 (-15), yellowish; teliospore heads (70-)80-105(-120) diam, 6-10(-12) cells across, brown; cysts appressed. Distribution: Sonora on *A. willardiana* Gray.

Ravenelia expansa Diet. & Holw. Fig. 2.
Life cycle unknown. Urediniospores (13-)15-18(-20) x (11-)13-16 (18-), golden; teliospore heads (55-)60-90(-100) diam, (4)5 or 6(7) cells across, brown; cysts pendent. Distribution: Baja California Sur and Sonora on *A. goldmanii* Rose, *A.* sp.

Ravenelia pringlei Cumm. Fig. 3.
Life cycle macrocyclic, autoecious. Aecia uredinoid on witches' brooms, spores (20-)26-33(-35) x (10-)11-15(-17), golden; urediniospores as the aeciospores; teliospore heads (55-)70-95(-105) diam, (5)6-8 cells across, brown; cysts appressed or semipendent. Distribution: Arizona, California, and Sonora on *A. greggii* Gray, *A. wrightii* Benth.

Ravenelia scopulata Cumm. & J. W. Baxt. Fig. 4.
Life cycle demicyclic, autoecious, all spore forms on witches' brooms. Aecia uredinoid, spores (17-)19-24(-27) x (11-)12-14(-15), brown; teliospore heads (55-)65-100(-110) diam, 5-8 cells across, brown; cysts semipendent. Distribution: Sonora on *A. greggii* Gray, *A. occidentalis* Rose.

Ravenelia thornberiana Long. Fig. 5.
Life cycle macrocyclic, autoecious. Aecia uredinoid on witches' brooms, spores (18-)22-27(-30) x (12-)14-17(-19), brown; urediniospores as the aeciospores; teliospore heads (65-)75-98(-105) diam, (4)5-7 cells across, brown; cysts pendent. Distribution: Arizona

and Sonora on *A. constricta* Benth.

ACALYPHA (Euphorbiaceae)

Puccinia dietelii aecial stage; see *Chloris.*

ALLIUM (Liliaceae)

Puccinia blasdalei Diet. & Holw. Fig. 38.

Life cycle macrocyclic, autoecious. Aecia aecidioid, spores (18-) 20-27(-30) x (15-)18-22(-24), colorless; urediniospores (21-)23-28 (-30) x (17-)19-22(-24), yellowish; teliospores in locules, (30-) 35-50(-60)x (17-)20-25(-27), brown. Distribution: Arizona on *Allium macropetalum* Rydb.

ALTHAEA (Malvaceae)

Puccinia malvacearum Bert. ex Mont.; see addendum.

AMBROSIA (Compositae)

Puccinia franseriae Syd. Fig. 21.

Life cycle macrocyclic, autoecious. Aecia uredinoid, spores as the urediniospores; urediniospores (23-)25-32(-38) x (18-)20-28(-30), brown; teliospores (32-)37-52(-59)x(23-)25-30(-33), brown. Distribution: Arizona, California, and Sonora on *A. deltoidea* (Torr.) Payne, *A. dumosa* (Gray) Payne.

Puccinia sonorae J. Parm. Fig. 19.

Life cycle macrocyclic, autoecious. Aecia aecidioid, spores 24-29 x 17-22, colorless; urediniospores (17-)18-22(-24) x (15-)17-20(-22), brown; teliospores (26-)30-38(-42) x (18-)20-24(-26), brown. Distribution: Baja California and Sonora on *A. carduacea* (Greene) Payne, *A. cordifolia* (Gray) Payne.

ANEMONE (Ranunculaceae)

Tranzschelia cohaesa Long. Fig. 27.

Life cycle macrocyclic, autoecious. Aecia aecidioid, systemic, spores (18-)20-24(-28) x (16-)17-20(-22), yellowish; urediniospores (22-)25-35(-40) x (16-)18-20(-23), brownish; teliospores (24-)30-40 (-44) x (15-)18-22(-24), dark brown. Distribution: Arizona and Sonora on *A. tuberosa* Rydb.

ANISACANTHUS (Acanthaceae)

Puccinia anisacanthi Diet. & Holw. Fig. 23.

Life cycle macrocyclic, autoecious. Aecia aecidioid, spores 25-36 x 17-24, yellowish; urediniospores (23-)25-29(-32) x (15-)17-23(-25), brown; teliospores (35-)39-50(-53) x (24-)26-30(-34), brown. Distribution: Arizona and Sonora on *A. thurberi* (Torr.) Gray, *Carlowrightia arizonica* Gray, *C. cordifolia* Gray, *C. glabrata* Fern.

ANTIRRHINUM (Scrophulariaceae)

Puccinia antirrhini Diet. & Holw.; see addendum.

ARISTIDA (Gramineae)

Puccinia aristidae Tracy var. *chaetariae* Cumm. & Husain. Fig. 22.

Life cycle macrocyclic, heteroecious. Aecia aecidioid on *Boerhaavia* but above the desert; urediniospores 23-30(-32) x (19-)21-26 (-29), brown; teliospores (29-)32-44(-50) x (19-)22-28(-32), brown. Distribution: Arizona and Sonora on *A. adscencionis* L.

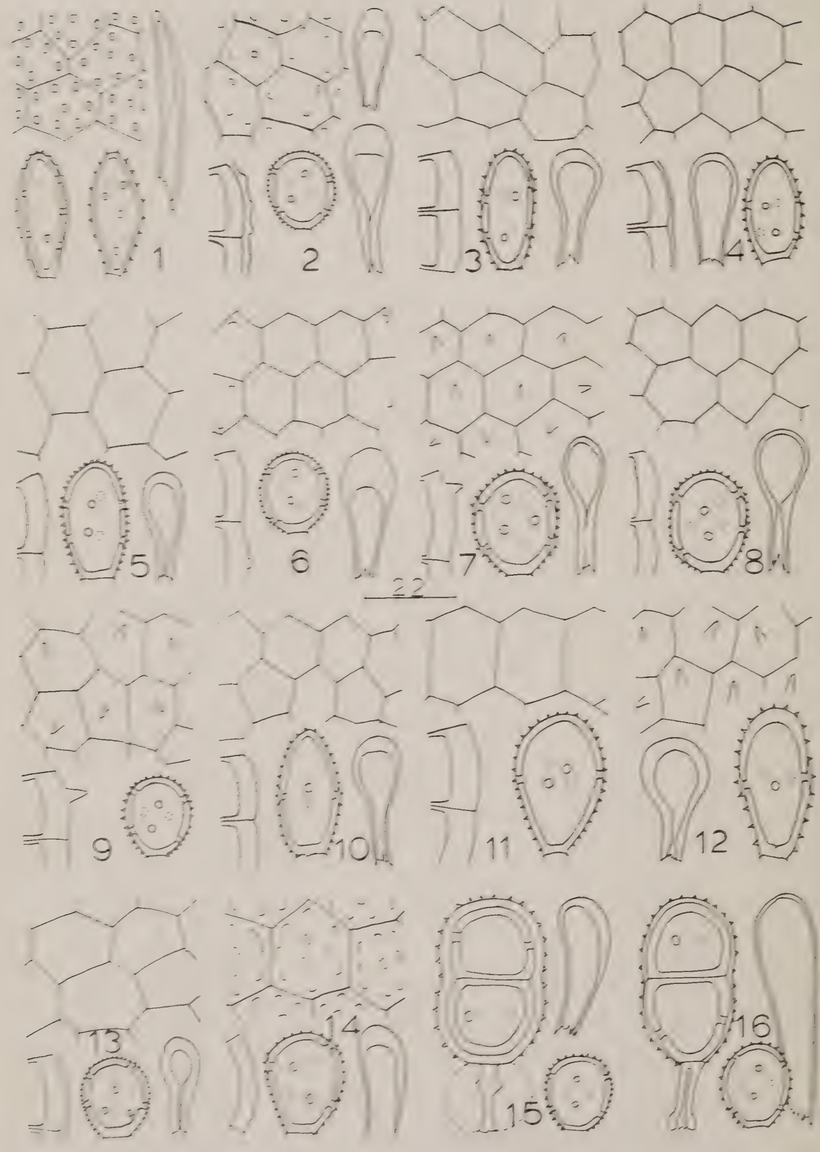
Puccinia sonorica Cumm. & Husain, var. *sonorica.* Fig. 20.

Life cycle unknown. Urediniospores (23-)25-30(-33) x (18-)20-24 (-25), brown; teliospores (29-)32-37(-40) x (21-)23-26(-28), brown. Distribution: Arizona and Sonora on *A. hamulosa* Henr., *A. ternipes* Cav.

ARTEMISIA (Compositae)

Puccinia cnici-oleracei Pers. ex Desm. Fig. 28.

Life cycle microcyclic. Teliospores (32-)37-54(-60) x (13-)15-20 (-23), brown. Distribution: Arizona on *A. ludoviciana* Nutt.



ASPARAGUS (Liliaceae)

Puccinia asparagi DC.; see addendum.

ASTER (Compositae)

Uromyces compactus Peck. Fig. 78.

Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (26-)28-35(-40) x (20-)22-27(-30), colorless; urediniospores (30-)32-40(-46) x (20-)23-28(-31), brown; teliospores (28-)33-42(-48) x (19-)22-28(-30), brown. Distribution: Sonora on *A. spinosus* Benth.

ASTRAGALUS (Leguminosae)

Uromyces punctatus Schroet. Fig. 80.

Life cycle macrocyclic, heteroecious. Aecia systemic, aecidioid, on *Euphorbia*, but not known in area. Urediniospores (19-)22-28(-30) x (17-)19-23(-25), brown; teliospores (17-)19-25 x (14-)17-24, brown. Distribution: Arizona and California on *A. allochrous* Gray, *A. crotalariae* (Benth.) Gray, *A. lentiginosus* Dougl.

ATRIPLEX (Chenopodiaceae)

Uromyces shearianus Arth. Fig. 75.

Life cycle demicyclic, autoecious. Aecia systemic, aecidioid, aeciospores (18-)22-27(-33) x (13-)17-20(-22), colorless; teliospores (23)25-31(-33) x (18-)20-23(-26), brownish. Distribution: Arizona on *A. polycarpa* Wats.

BACCHARIS (Compositae)

Puccinia baccharidis Diet. & Holw. Fig. 24.

Life cycle macrocyclic, autoecious. Aecia caeomoid, aeciospores (27-)30-48(-60) x (20-)22-26(-30), colorless; urediniospores (28-)32-43(-46) x (17-)20-24(-27), yellowish; teliospores (45-)50-68(-72) x (22-)24-28(-31), brownish. Distribution: Arizona on *B. glutinosa* Pers.

Puccinia evadens Hark. Fig. 25.

Life cycle macrocyclic, autoecious. Aecia caeomoid, aeciospores (32-)36-55(-60) x (17-)23-25(-28), colorless; urediniospores (25-)30-38(-42) x (19-)22-27(-30), yellowish; teliospores (48-)54-74(-80) x (22-)26-30(-33), brownish. Distribution: Arizona on *B. emoryii* Gray, *B. sarothroides* Gray.

BAILEYA see *Psilostrophe*.

BELOPERONE (Acanthaceae)

Uromyces beloperones G. F. Laun. Fig. 79.

Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores (23-)26-30(-33) x (19-)21-25(-27), brown; urediniospores as the aeciospores; teliospores (26-)30-40(-44) x (22-)24-30(-33), dark brown. Distribution: Arizona, Baja California, California, and Sonora on *B. californica* Benth.

BETA (Chenopodiaceae)

Uromyces betae (Pers.) Tul.; see addendum.

BOGENHARDIA = *Herissantia*, which see.

BOUTELOUA (Gramineae)

Puccinia cacabata Arth. & Holw. Fig. 26.

Life cycle macrocyclic, heteroecious. Aecia aecidioid on *Gossypium*,

---

Figure 1-16. Species of *Ravenelia* and *Uropyxis*; teliospores and urediniospores. 1. *R. cumminsii*. 2. *R. expansa*. 3. *R. pringlei*. 4. *R. scopulata*. 5. *R. thornberiana*. 6. *R. humphreyana*. 7. *R. spinulosa* v. *papillifera*. 8. *R. mesilliana*. 9. *R. bajacalensis*. 10. *R. lysilomae*. 11. *R. epiphylla*. 12. *R. arizonica*. 13. *R. fragrans* v. *evernia*. 14. *R. piscidiae*. 15. *U. daleae* v. *eysenhardtiae*. 16. *U. nissoliae*.

aeciospores 16-21 x 15-16, colorless; urediniospores (22-)24-30(-32) x (17-)19-23(-25), brown; teliospores (27-)34-40(-44) x (17-)20-24 (-26), brown. Distribution: Arizona and Sonora on *B. aristidoides* (H.B.K.) Griseb., *B. barbata* Lag., cultivated cotton.

Puccinia vexans Farl. Fig. 31.

Life cycle macrocyclic, heteroecious. Aecia aecidioid on *Fouquieria,* aeciospores 27-32(-34) x 23-27(-30), colorless; ordinary urediniospores 26-30 x 23-29, pale brown; amphispores 34-42 x 26-35, dark brown, *Uromyces*-like; teliospores 32-40 x (19-)23-29, brown. Distribution: Arizona and Sonora on *B. curtipendula* (Michx.) Torr., *F. splendens* Engelm.

BOUVARDIA (Rubiaceae)

Puccinia diplachnis aecial stage; see *Leptochloa.*

BRAYULINEA (Amaranthaceae)

Puccinia guillemineae Diet. & Holw. Fig. 29.

Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (15-)17-22(-24) x (12-)15-18, colorless; urediniospores (18-)20-24 (-26) x (16-)18-20(-22), brownish; teliospores (28-)30-38(-41) x (16-)19-23(-25), brown. Distribution: Arizona on *B. densa* (Willd.) Small.

CAESALPINIA (Leguminosae)

Ravenelia humphreyana P. Henn. Fig. 6.

Life cycle unknown. Urediniospores (15-)17-19(-20) x (13-)14-17 (-18); teliospore heads (60-)70-100(-120) diam, 5-8 cells across; cysts appressed to semipendent. Distribution: Sonora on *C. caladenia* Standl., *C. palmeri* Wats., *C. pulcherrima* (L.) Swartz.

CAMISSONIA (Onagraceae)

Puccinia oenotherae Vize. Fig. 32.

Life cycle macrocyclic, autoecious. Aecia systemic, aecidioid, spores 18-23 x 13-18, colorless; urediniospores (20-)22-26(-28) x (16-)18-22(-24), brown; teliospores (28-)32-45(-50) x (17-)19-24 (-26), brown. Distribution: Arizona, Baja California Sur, and Sonora on *C. brevipes* (Gray) Raven, *C. californica* (Nutt.) Raven, *C. claviformis* (Torr. & Frêm.) Raven.

CARDIOSPERMUM (Sapindaceae)

Puccinia arechavaletae Speg. Fig. 30.

Life cycle microcyclic. Teliospores mostly 20-30 x 13-20 but giant spores common, 1-celled spores usually commoner than 2-celled. Distribution: *C. corindum* L. in Sonora.

CARLOWRIGHTIA see *Anisacanthus*

CARTHAMUS (Compositae)

Puccinia calcitrapae DC. var. *centaureae* (DC) Cumm.; see addendum.

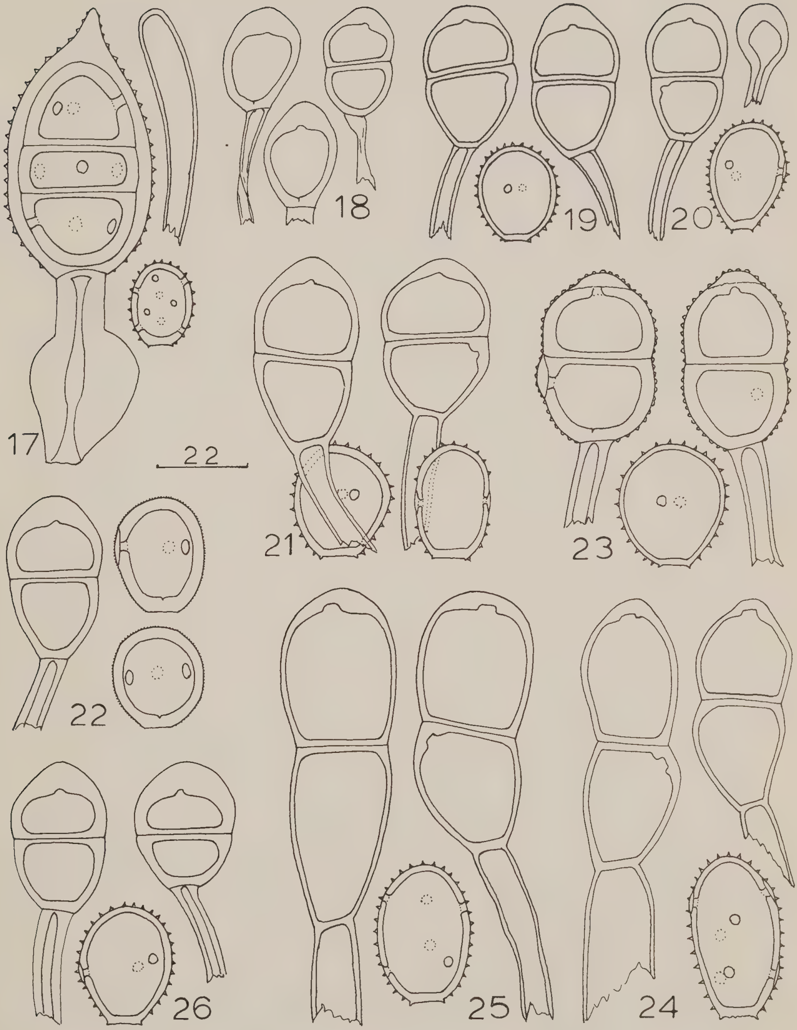
CASSIA (Leguminosae)

Ravenelia mesillana Ellis & Barth. Fig. 8.

Life cycle macrocyclic, autoecious. Aecia uredinoid, spores as the urediniospores; urediniospores (19-)22-26(-29) x (15-)17-19(-21), brown; teliospore heads (60-)80-115(-150) diam, (5)6-9(10) cells across; cysts pendent, multiseriate. Distribution: Arizona and Sonora on *Cassia covesii* Gray.

Ravenelia spinulosa Diet. & Holw. var. *papillifera* (Syd.) Cumm. & J. W. Baxt. Fig. 7.

Life cycle macrocyclic, autoecious. Aecia uredinoid, spores as the urediniospores; urediniospores (18-)19-22(-24) x (14-)16-19(-20), golden brown; teliospore heads (60-)75-110(-120) diam, 6-9 cells across; cysts pendent, multiseriate. Distribution: Sonora on *C. covesii* Gray (with uredinia only).



Figures 17-26. Species of *Phragmopyxis* and *Puccinia*; teliospores and urediniospores. 17. *Phrag. noelii*. 18. *Puccinia heterospora*. 19. *P. sonorae*. 20. *P. sonorica*. 21. *P. franseriae*. 22. *P. aristidae* v. *chaetariae*. 23. *P. anisacanthae*. 24. *P. baccharidis*. 25. *P. evadens*. 26. *P. cacabata*.

CENTAUREA (Compositae)

Puccinia acroptili Syd. Fig. 35.
Life cycle unknown. Urediniospores (21-)23-26(-29) x (18-)19-23(-24), brown; teliospores (30-)35-40(-50) x (18-)22-27(-30), brown. Distribution: Arizona on *Centaurea picris* Pall. Both host and fungus adentive to North America.

CHLORIS (Gramineae)

Puccinia dietelii Sacc. & Syd. Fig. 34.
Life cycle macrocyclic, heteroecious. Aecia aecidioid, on *Acalypha* spp. but not known in the area; urediniospores 17-26 x 15-21, colorless; teliospores 24-35 x 17-24, brown. Distribution: Arizona and Sonora on *C. virgata* Swartz.

CHRYSANTHEMUM (Compositae)

Puccinia tanaceti DC. var. *tanaceti*; see addendum.

CIRSIUM (Compositae)

Puccinia californica Diet. & Holw. Fig. 36.
Life cycle unknown. Urediniospores (25-)27-32(-36) x (20-)23-27(-30), brown; teliospores (33-)37-53(-59) x (21-)25-30(-33), brown. Distribution: Arizona on *C. arizonicum* (Gray) Petr., upper limits of the desert.

CONVOLVULUS (Convolvulaceae)

Puccinia convolvuli Cast.; see addendum.

COURSETIA (Leguminosae)

Phragmopyxis acuminata (Long) Syd.
Life cycle microcyclic. Teliospores as in *P. noelii*. Distribution: Arizona on *C. glandulosa* Gray.

Phragmopyxis noelii J. W. Baxt. Fig. 17.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores (15-)18-22(-25) x (13-)15-18(-20), golden brown; urediniospores as the aeciospores; teliospores (50-)56-75(-95) x (30-)33-40(-45), dark brown. Distribution: Arizona and Sonora on *C. glandulosa* Gray.

CRESSA (Convolvulaceae)

Puccinia tuyutensis Speg. Fig. 40.
Life cycle macrocyclic, autoecious. Aecia aecidioid, systemic; aeciospores 18-26 x 15-22, colorless; urediniospores (25-)27-31(-33) x (18-)20-23(-25), brown; teliospores (30-)33-42(-45) x (19-)21-24(-26), golden brown. Distribution: Arizona, Baja California, and Sonora on *C. truxillensis* H.B.K.

CROTON (Euphorbiaceae)

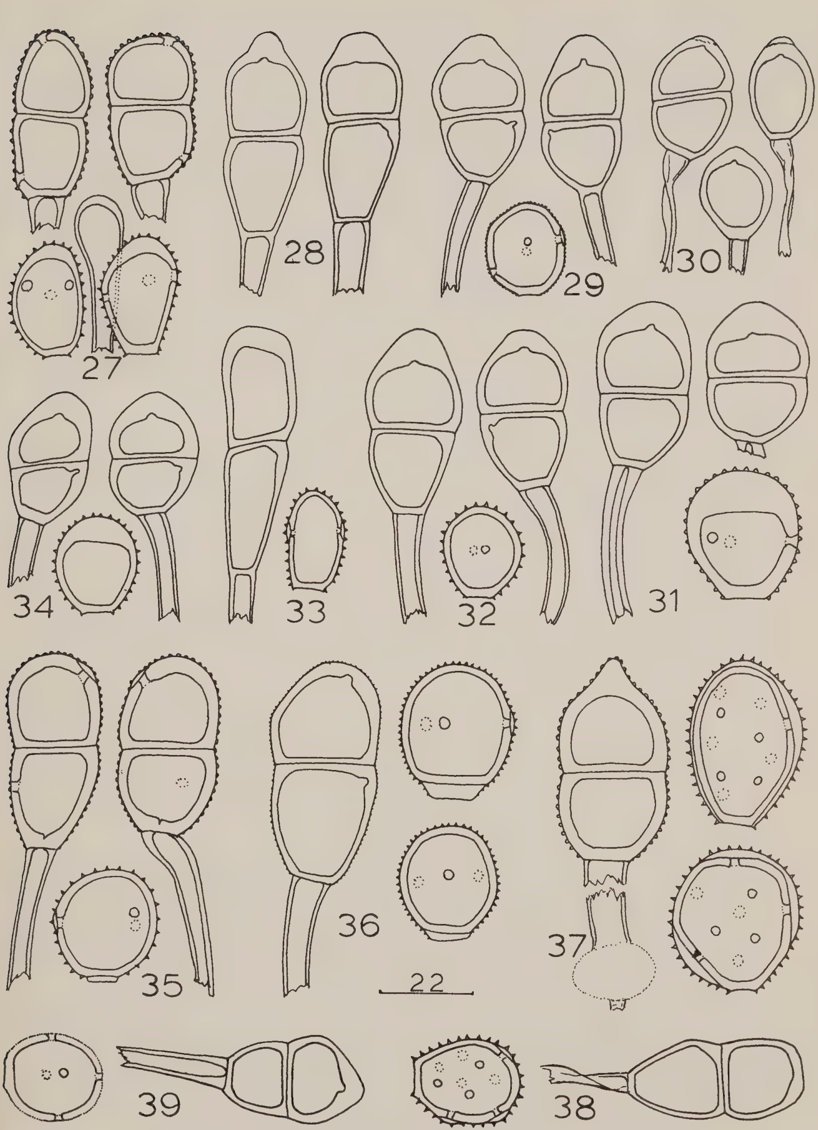
Phakopsora crotonis (Burr.) Arth. Fig. 51.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores as the urediniospores; urediniospores 22-32 x 16-21, yellowish; teliospores 24-40 x 10-15, brown. Distribution; Arizona on *C. texensis* (Klotz.) Muel.-Arg.

CYNODON (Gramineae)

Puccinia cynodontis Lacr. ex Desm. Fig. 41.
Life cycle macrocyclic, heteroecious. Aecia aecidioid, not known in N. America; urediniospores 20-26 x 19-23, brown; teliospores 30-55 x 16-22, brown. Distribution: Arizona, California, and Sonora on *C. dactylon* (L.) Pers.

CYPERUS (Cyperaceae)

Puccinia canaliculata (Schw.) Lager. Fig. 33.
Life cycle macrocyclic, heteroecious. Aecia aecidioid on genera of Heliantheae but not recorded in the desert, aeciospores (13-)15-18(-20) x 13-15(-17), colorless; urediniospores (18-)21-26(-28) x (13-)14-17(-19), brown; teliospores (40-)45-62(-65) x (14-)16-20(-22) in


27
28
29
30
34
33
32
31
35
36
22
37
39
38

Figures 27-39. Species of *Tranzschelia* and *Puccinia*; teliospores and urediniospores. 27. *T. cohaesa*. 28. *P. cnici-oleracei*. 29. *P. guillemineae*. 30. *P. arechavaletae*. 31. *P. vexans*. 32. *P. oenotherae*. 33. *P. canaliculata*. 34. *P. dietelii*. 35. *P. acroptili*. 36. *P. californica*. 37. *P. velata*. 38. *P. blasdalei*. 39. *P. subnitens*.

stromatic locules, brown. Distribution: Sonora on *C. esculentus* L.

DICHELOSTEMMA (Liliaceae)

Puccinia nodosa Ell. & Hark. Fig. 42.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 26-32(-36) x (20-)22-27(-32), colorless; urediniospores (26-)28-33 (-38) x (22-)24-28(-30), brownish; teliospores (40-)44-54(-60) x (25-)28-32, dark brown, opaque. Distribution: Arizona and Baja California on *D. pulchellum* (Salisb.) Hell., *Triteleiopsis palmeri* (Wats.) Hoov.

DICLIPTERA see *Tetramerium*

DISTICHLIS (Gramineae)

Puccinia subnitens Diet. Fig. 39.
Life cycle macrocyclic, heteroecious. Aecia aecidioid on several families but not recorded in the desert, aeciospores 15-23 x 13-21, colorless; urediniospores (19-)20-24(-26) x 19-24(-25), brownish; teliospores (30-)36-46(-55) x (17-)19-24(-27), brown. Distribution: Arizona on *D. stricta* (Torr.) Rydb.

ERAGROSTIS (Gramineae)

Uromyces eragrostidis Tracy. Fig. 81.
Life cycle macrocyclic, heteroecious. Aecia aecidioid, on *Anthericum* but above the desert; urediniospores (20-)21-29(-31) x (16-)18-23(-26), pale brown; teliospores (22-)23-31(-34) x (16-)18-23(-25), brown. Distribution: Arizona on *E. intermedia* Hitch. but usually above the desert.

ERIASTRUM (Polemoniaceae)

Puccinia giliae Hark. Fig. 44.
Life cycle unknown. Urediniospores (21-)24-27(-30) x (18-)19-22 (-24), brown; teliospores (38-)42-58(-62) x (18-)20-26(-29), brown. Distribution: Arizona on *E. diffusum* (Gray) Mason.

ERIOCHLOA (Gramineae)

Uromyces setariae-italicae Yosh. Fig. 85.
Life cycle macrocyclic, heteroecious. Aecia aecidioid, on *Cordia* but not known in the region; urediniospores (25-)27-33(-35) x (20-) 22-28(-30), brown; teliospores (16-)18-26(-30) x (14-)16-20, brown. Distribution: Sonora on *E. gracilis* (Fourn.) Hitch.

ERIOGONUM (Polygonaceae)

Uromyces intricatus Cooke. Fig. 82.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 19-25(-29) x (14-)16-21(-24), colorless; urediniospores (27-)30-33 x (24-)26-30, brown; teliospores (26-)30-40(-44) x (20-)24-30(-33), brown. Distribution: Arizona on *E. deflexum* Torr., *E. fasciculatum* Benth., *E. wrightii* Torr.

EUPATORIUM (Compositae)

Puccinia eupatorii Diet. Fig. 45.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores (30-)33-40(-43) x (26-)28-33, dark brown; urediniospores as the aeciospores but 28-34(-38) x 25-30(-32); teliospores (38-)40-52(-56) x (28-)30-34, golden brown. Distribution: Sonora on *E. sagittatum* Gray.

EUPHORBIA (Euphorbiaceae)

Puccinia velata Arth. Fig. 37.
Life cycle unknown. Urediniospores (28-)30-38(-40) x (20-)22-26 (-28), golden; teliospores (42-)45-60(-65) x (24-)27-32(-34), dark brown. Distribution: Baja California and Sonora on *E. californica* Benth., *E. leucophylla* Benth., *E. misera* Benth.

Uromyces euphorbiae Cooke & Peck. Fig. 84.
Life cycle macrocyclic, autoecious. Aecia systemic, aecidioid, aeciospores 15-19 x 12-16, colorless; urediniospores (16-)18-21 x (15-)16-18(-20), brown; teliospores (19-)21-24(-26) x (15-)17-19 (-21), brown. Distribution: Arizona and Sonora on *E. albomarginata* Torr. & Gray, *E. chamaesyce* L., *E. micromeria* Boiss., *E. polycarpa* Benth.

Uromyces tranzschelii Syd. Fig. 83.
Life cycle microcyclic. Telia systemic, teliospores (15-)20-26(-30) x (13-)17-20(-23), brown. Distribution: Arizona and Baja California on *E. lurida* Engelm., *E. palmeri* Engelm. but usually above the desert.

EVOLVULUS (Convolvulaceae)

Puccinia lithospermi Ell. & Kell. Fig. 47.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 16-21 x 13-16, colorless; urediniospores (20-)22-26 x (16-)18-21 (-23), brownish; teliospores (33-)40-60(-64) x (16-)18-24(-28), brown. Distribution: Sonora on *E. alsinoides* L. var. *acapulcensis*.

EYSENHARDTIA (Leguminosae)

Uropyxis daleae (Diet. & Holw.) Magn. var. *eysenhardtiae* (Diet. & Holw.) J. W. Baxt. Fig. 15.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores as urediniospores; urediniospores 15-21 x 14-17, brownish; teliospores 35-45 x 22-28, brown. Distribution: Sonora on *E. orthocarpa* (Gray) Wats.

FOUQUIERIA (Fouquieriaceae)

Puccinia vexans aecial stage; see *Bouteloua*.

FRANSERIA = *Ambrosia*, which see.

FUNASTRUM = *Sarcostemma*, which see.

GOSSYPIUM (Malvaceae)

Puccinia cacabata aecial stage; see *Bouteloua*.

GOUANIA (Rhamnaceae)

Puccinia invaginata Arth. & J. R. John. Fig. 46.
Life cycle unknown. Urediniospores (24-)26-31(-33) x 17-24(-26), brown; teliospores (30-)34-40(-45) x (24-)27-30(-33), brown. Distribution: Baja California Sur on *G. rosei* Wigg.

GUTIERREZIA see *Haplopappus*

HAPLOPAPPUS (Compositae)

Puccinia grindeliae Peck ssp. *grindeliae*. Fig. 54.
Life cycle microcyclic. Teliospores (34-)40-58(-64) x (18-)20-26 (-28), brown. Distribution: Arizona on *Gutierrezia californica* (DC.) Torr. & Gray, *G. sarothrae* (Pursh) Britt. & Rusby, *H. spinulosus* (Pursh) DC.

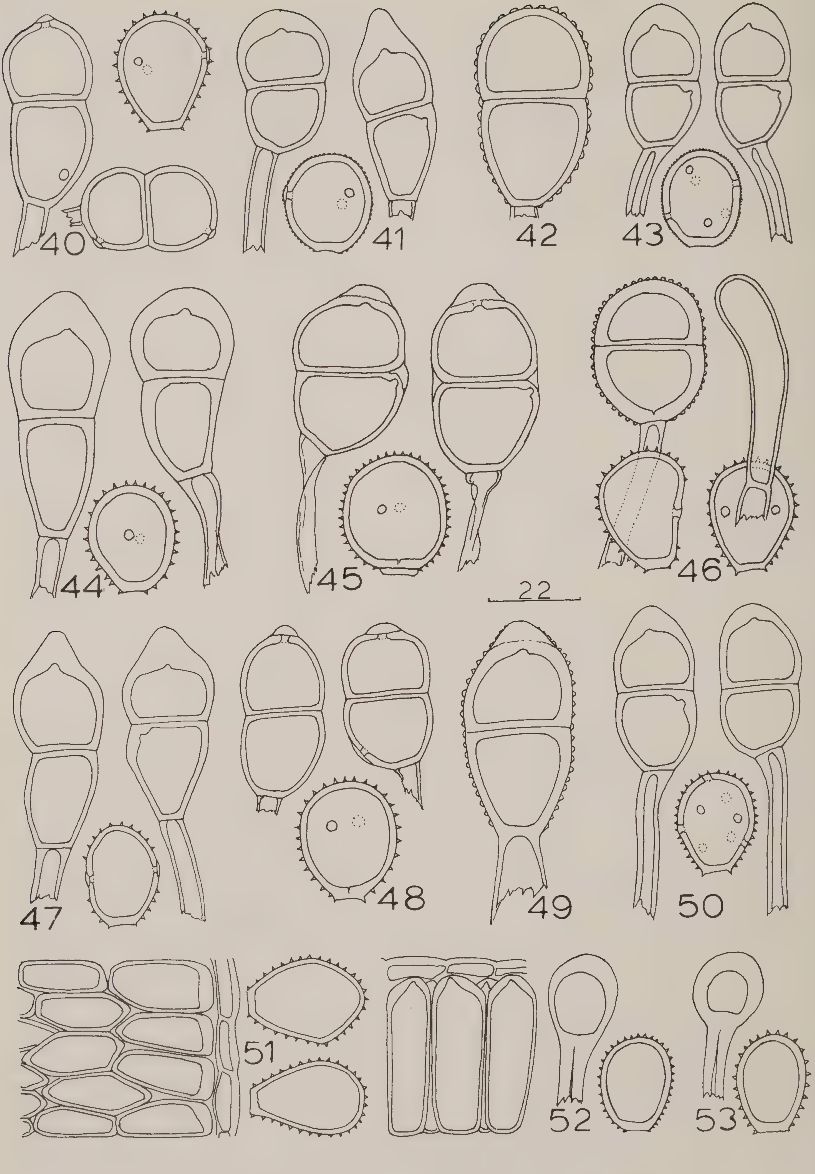
HELIANTHUS (Compositae)

Puccinia helianthi Schw. Fig. 69.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (16-)20-25(-30) x (13-)16-21(-23), colorless; urediniospores (23-) 26-33(-38) x (14-)18-28(-32), brown; teliospores (33-)38-60(-70) x (18-)21-30(-33), brown. Distribution: Arizona, California, and Sonora on *H. annuus* L., *H. petiolaris* Nutt.

HERISSANTIA see *Abutilon*

HYDROCOTYLE (Umbelliferae)

Puccinia hydrocotyles Cooke. Fig. 48.
Life cycle unknown. Urediniospores (24-)26-31(-35) x (20-)22-27 (-30), brown; teliospores (32-)35-40(-44) x 20-23(-25), golden brown. Distribution: Arizona on *Hydrocotyle verticillata* Thunb.



Figures 40-53. Species of *Puccinia*, *Phakopsora* and *Melampsora*; teliospores and urediniospores. 40. *Puccinia tuyutensis*. 41. *P. cynodontis*, 42. *P. nodosa*. 43. *P. leptochloae*. 44. *P. giliae*. 45. *P. eupatorii*. 46. *P. invaginata*. 47. *P. lithospermi*. 48. *P. hydrocotyles*. 49. *P. megalospora*. 50. *P. diplachnis*. 51. *Phakopsora crotonis*. 52. *Melampsora lini*. 53. *M. paradoxa*.

HYMENOCLEA (Compositae)

Puccinia franseriae Syd., see under *Ambrosia*.

Puccinia splendens Vize. Fig. 55.

Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (22-)24-32 x (19-)21-25(-27), colorless; urediniospores (24-)26-33 (-36) x (22-)24-27(-29), brown; teliospores mostly on stem galls, (40-)44-65(-68) x (26-)29-35(-40), brown. Distribution: Arizona, Baja California, California, and Sonora on *H. monogyra* Torr. & Gray, *H. salsola* Torr. & Gray.

HYPTIS (Labiatae)

Puccinia distorta Holw. Fig. 57.

Life cycle microcyclic. Teliospores, often on galls or distortions, (28-)32-40(-44) x (18-)22-25(-27), brown. Distribution: Arizona, California, and Sonora on *H. emoryi* Torr.

INDIGOFERA (Leguminosae)

Uromyces indigoferae Diet. & Holw. Fig. 86.

Life cycle unknown. Urediniospores (20-)23-28 x (16-)18-20(-22), brown; teliospores (22-)25-30(-33) x (15-)17-21(-23), brown. Distribution: Sonora on *I. laevis* Rydb.

IPOMOEA (Convolvulaceae)

Puccinia megalospora (Orton) Arth. & J. R. John. Fig. 49.

Life cycle demicyclic, autoecious. Aecia aecidioid, aeciospores (22-)25-30(-34) x (19-)21-25(-28), colorless; teliospores (42-)46-64(-68) x (23-)25-33(-35), dark brown. Distribution: Sonora on *I. arborescens* (Humb. & Bonpl.) G. Don.

JACOBINIA see *Tetramerium*

KECKIELLA (Scrophulariaceae)

Puccinia confraga Arth. & Cumm. Fig. 56.

Life cycle microcyclic. Teliospores 26-29(-31) x (31-)33-37(-40), dark brown. Distribution: Arizona on *K. antirrhinoides* (Benth.) Straw ssp. *microphylla* (Gray) Straw.

LAGASCEA (Compositae)

Puccinia praetermissa J. Parm. Fig. 59.

Life cycle unknown. Urediniospores (19-)21-26(-28) x (17-)20-23 (-25), brown; teliospores (32-)35-45(-53) x (20-)23-30(-35), dark brown. Distribution: Sonora on *L. decipiens* Hemsl.

LEPTOCHLOA (Gramineae)

Puccinia diplachnis Arth. Fig. 50.

Life cycle macrocyclic, heteroecious. Aecia aecidioid on *Bouvardia glaberrima* Engl., aeciospores 20-26(-28) x (17-)19-23, colorless; urediniospores (20-)22-26(-28) x (18-)20-24(-26), colorless; teliospores (28-)32-40(-44) x (16-)19-25(-28), brown. Distribution: Arizona on *L. dubia* (H.B.K.) Nees at the upper limit of the desert.

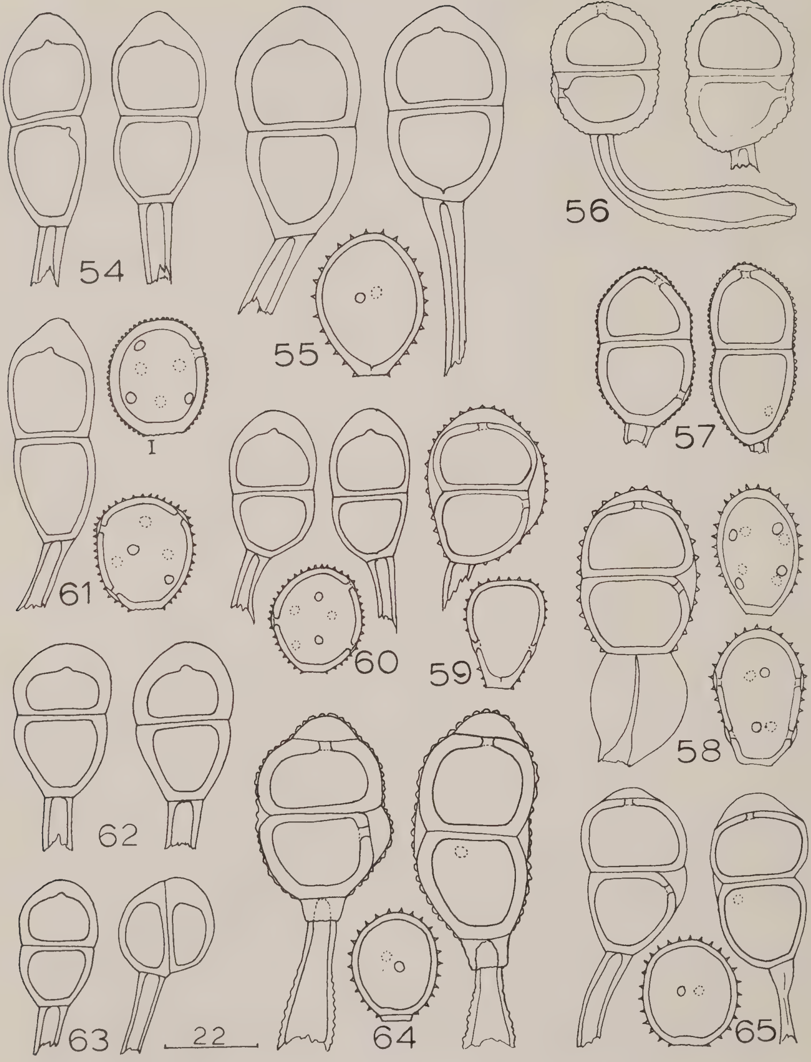
Puccinia leptochloae Arth. & Fromme. Fig. 43.

Life cycle macrocyclic, heteroecious. Aecia aecidioid on *Talinum paniculatum* (Jacq.) Gaert., aeciospores 17-21(-24) x 14-16(-18), colorless; urediniospores 19-26 x (16-)18-24, brown; teliospores (24-)27-33(-38) x (16-)18-22(-25), brown. Distribution: Sonora on *L. filiformis* (Lam.) Beauv.

LIMONIUM (Plumbaginaceae)

Uromyces limonii (DC.) Lév. Fig. 87.

Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (22-)24-30(-33) x (19-)21-25(-27), colorless; urediniospores (25-)29-33(-38) x (20-)22-28(-31), brown; teliospores (26-)28-38(-40) x (17-)19-26(-28), brown. Distribution: Arizona and Baja California on *L. californicum* (Boiss.) Hell.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Figures 54-65. Species of *Puccinia* teliospores and urediniospores. 54. *P. grindeliae* ssp. *grindeliae*. 55. *P. splendens*. 56. *P. confraga*. 57. *P. distorta*. 58. *P. globosipes*. 59. *P. praetermissa*. 60. *P. schedonnardi*. 61. *P. grindeliae* ssp. *riddelliae*. 62. *P. lobaba*. 63. *P. obliqua*. 64. *P. tetramerii*. 65. *P. invelata*.

LINUM (Linaceae)

Melampsora lini (Ehren.) Lev̂. Fig. 52.

Life cycle macrocyclic, autoecious. Aecia caeomoid, aeciospores 21-28 x 19-27, colorless; urediniospores 15-25 x 13-20, colorless; teliospores 42-50 x 10-20, brown. Distribution: Arizona on *L. lewisii* Pursh.

LOLIUM (Gramineae)

Puccinia graminis Pers.; see addendum.

LYCIUM (Solanaceae)

Puccinia globosipes Peck. Fig. 58.

Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores as the urediniospores; urediniospores (18-)20-25(-27) x (27-)30-42(-46), brown; teliospores (30-)34-40(-46) x (24-)27-34(-37), dark brown. Distribution: Arizona, Baja California, California and Sonora on *L. andersonii* Gray., *L. berlandieri* Dunal, *L. brevipes* Benth., *L. exsertum* Gray, *L. fremontii* Gray, *L. parishii* Gray.

LYCURUS see *Muhlenbergia*.

LYSILOMA (Leguminosae)

Ravenelia bajacalensis Cumm. & J. W. Baxt. Fig. 9.

Life cycle unknown. Urediniospores (15-)16-19(-21) x (11-)13-16(-17), yellowish; teliospore heads (74-)80-110(-120) diam, (6)7-9 (10) cells across, brown; cysts pendent, multiseriate. Distribution: Baja California Sur on *L. candida* Brand.

Ravenelia lysilomae Arth. Fig. 10.

Life cycle unknown. Urediniospores (24-)27-33(-37) x (11-)13-17(-19), brown; teliospore heads (75-)80-110(-120), diam, (6)7-9 cells across, brown; cysts appressed. Distribution: Baja California and Sonora on *L. divaricata* (Jacq.) Macb., *L. candida* Brand.

MALVELLA (Malvaceae)

Puccinia lobata Berk. & Curt. Fig. 62.

Life cycle microcyclic. Teliospores (28-)33-40(-44) x (16-)19-26(-29), golden to brown. Distribution: Arizona, California, and Sonora on *M. lepidota* (Gray) Fryx., *M. leprosa* (Ort.) Krap.

MEDICAGO (Leguminosae)

Uromyces striatus Schroet.; see addendum.

MERREMIA (Convolvulaceae)

Uromyces sonorensis Hennen & Cumm. Fig. 89.

Life cycle unknown. Urediniospores (28-)30-38(-42) x (20-)21-24(-26), golden brown; teliospores (28-)30-40(-43) x 24-30(-32), dark brown. Distribution: Sonora on *M. palmeri* (Wats.) House.

MIMOSA (Leguminosae)

Ravenelia fragrans Long var. *evernia* (Syd.) J. W. Baxt. Fig. 13.

Life cycle unknown. Urediniospores (15-)18-23(-26) x (13-)15-19(-21), golden; teliospore heads (55-)60-100(-110) diam, (4)5-7(8) cells across; cysts pendent. Distribution: Arizona and Sonora on *M. laxiflora* Benth.

Ravenelia fragrans Long var. *fragrans* is similar to var. *evernia* except the teliospore heads have bead-like warts, especially on the peripheral cells.

MUHLENBERGIA (Gramineae)

Puccinia schedonnardi Kell. & Swing. Fig. 60.

Life cycle macrocyclic, heteroecious. Aecia aecidioid on Malvaceae but unknown in the desert; urediniospores (18-)21-26(-30) x (15-)18-24(-28), brown; teliospores (24-)28-36(-45) x (16-)18-25(-29), brown. Distribution: Arizona and Sonora on *Lycurus phleoides* H.B.K., *M. porteri* Scrib., *M. repens* (Presl.) Hitch. but usually above the desert.

NISSOLIA (Leguminosae)

Uropyxis nissoliae (Diet. & Holw.) Magn. Fig. 16.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores (14-)15-18(-20) x (12-)14-16(-17), yellowish; urediniospores as the aeciospores. Teliospores (30-)33-38(-42) x (19-)21-24(-26), brown. Distribution: Sonora on *N. schottii* (Torr.) Gray.

OENOTHERA see *Camissonia*.

PARTHENICE (Compositae)

Puccinia invelata H. S. Jack. Fig. 65.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 19-30 x 16-24, colorless; urediniospores (19-)23-28(-30) x (16-)18-22(-24), brown; teliospores (32-)35-45(-50) x (20-)23-28(-30), brown. Distribution: Arizona on *P. mollis* Gray.

PELARGONIUM (Geraniaceae)

Puccinia pelargonii-zonalis Doidge; see addendum.

PENSTEMON see *Keckiella*.

PHASEOLUS (Leguminosae)

Uromyces appendiculatus (Pers.) Unger. Fig. 88.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (18-)20-28(-33) x (16-)18-20(-24), colorless; urediniospores (20-)24-30(-33) x (18-)20-25(-27), brown; teliospores (24-)28-33(-35) x (20-)22-27(-29), brown. Distribution: Sonora on *P. atropurpureus* DC. and widely distributed on garden bean, *P. vulgaris* L.

PHRYGILANTHUS (Loranthaceae)

Uromyces ornatipes Arth. Fig. 76.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 24-27 x 18-23, colorless; urediniospores (26-)30-40(-44) x (19-)21-24(-26), yellowish; teliospores (24-)28-34(-37) x (20-)22-26, dark brown. Distribution: Baja California Sur on *P. sonorae* Stand.

PISCIDIA (Leguminosae)

Ravenelia piscidiae Long. Fig. 14.
Life cycle unknown. Urediniospores (18-)20-22(-24) x (14-)16-20, brown; teliospore heads (60-)75-110(-120) diam, (3-)4-6 cells across, brown; cysts appressed. Distribution: Sonora on *P. mollis* Rose.

PLUCHEA (Compositae)

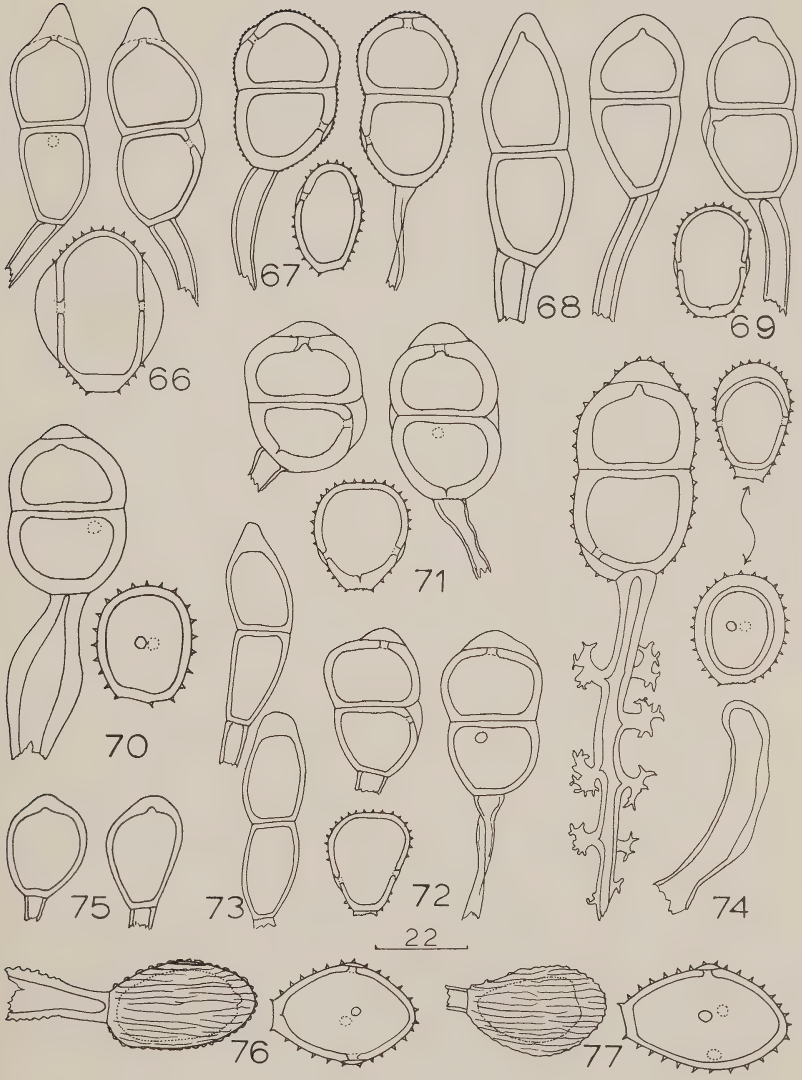
Puccinia ocellifera Cumm. Fig. 66.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 13-17 diam, colorless; urediniospores (24-)28-33(-35) x (22-)24-27, brown; teliospores (40-)43-55(-67) x (16-)18-24(-26), golden brown. Distribution: Baja California on *P. purpurascens* (SW.) DC.

PROSOPIS (Leguminosae).

Ravenelia arizonica Ell. & Ever. Fig. 12.
Life cycle macrocyclic, autoecious. Aecia on woody galls, uredinoid, aeciospores (25-)28-42(-44) x (15-)18-22, brown; urediniospores (30-)33-46(-50) x (16-)17-22(-24), brown; teliospore heads (60-)75-100(-110) diam, (5-)6-8(9) cells across, brown; cysts pendent, multiseriate. Distribution: Arizona and Sonora on *Prosopis glandulosa* Torr.

PSILOSTROPHE (Compositae)

Puccinia grindeliae ssp. *riddelliae* (Griff.) stat. nov. Fig. 61.
(*Gymnoconia riddelliae* Griff. Bull. Torrey Bot. Club 29:296. 1902).
Life cycle macrocyclic, autoecious, unstable (?). Aecia aecidioid, aeciospores (24-)26-30(-34) x (19-)22-25(27), yellowish; urediniospores uncommon, 24-30 x 23-25, yellowish; teliospores (40-)44-58



Figures 66-77. Species of *Puccinia, Prospodium* and *Uromyces*; teliospores and urediniospores. 66. *Puccinia ocellifera*. 67. *P. hieracii* v. *harknessii*. 68. *P. sherardiana*. 69. *P. helianthi*. 70. *P. turgidipes*. 71. *P. abrupta*. 72. *P. enceliae*. 73. *P. xanthii*. 74. *Prospodium appendiculatum*. 75. *Uromyces shearianus*. 76. *U. ornatipes*. 77. *U. socius*.

(-64) x (18-)21-26(-29), brown. Distribution: Arizona on *Baileya multiradiata* Harv. & Gray, *P. cooperi* (Gray) Greene.

RAFINESQUIA (Compositae)

Puccinia hieracii (Roeh.) Mart. var. *harknessii* (Vize) Cumm. Fig. 67.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores (22-)23-26(-30) x (16-)19-24(-26), brown; urediniospores as the aeciospores; teliospores (30-)33-40(-46) x (18-)21-25(-28), brown. Distribution: Arizona on *R. neomexicana* Gray, *Stephanomeria pauciflora* (Torr.) A. Nels.

SALIX (Salicaceae)

Melampsora paradoxa Diet. & Holw. Fig. 53.
Life cycle macrocyclic, heteroecious. Aecia caeomoid on *Larix* but not in the desert; urediniospores 17-24 x 15-19, colorless; teliospores 29-43 x 11-14, brown. Distribution: Arizona on *S. gooddingii* Ball, usually above the desert.

SARCOSTEMMA (Asclepiadaceae)

Puccinia obliqua Berk. & Curt. Fig. 63.
Life cycle microcyclic. Teliospores (20-)25-33(-40) x (15-)19-22 (-24), brown. Distribution: Arizona, California, and Sonora on *S. cynanchoides* Decn., *S. hirtellum* (Gray) R. Holm.

SIDA (in part), see *Malvella*.

SORGHUM (Gramineae)

Puccinia purpurea Cooke; see addendum.

SPHAERALCEA (Malvaceae)

Puccinia sherardiana Koern. Fig. 68.
Life cycle microcyclic. Teliospores (30-)44-64(-70) x (17-)20-28 (-31), brown. Distribution: Arizona and California on *S. ambigua* Gray, *S. angustifolia* (Cav.) G. Don, *S. emoryi* Woot. & Stand.

STEPHANOMERIA see *Rafinesquia*.

STRUTHANTHUS (Loranthaceae)

Uromyces socius Arth. & Holw. Fig. 77.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 26-35 x 23-27, colorless; urediniospores (35-)40-50(-55) x (16-)19-25(-27), golden; teliospores (27-)30-40(-44) x (17-)19-24, brown. Distribution: Sonora on *S. haenkeanus* (Presl) Stand.

SUAEDA (Chenopodiaceae)

Uromyces giganteus Speg. Fig. 90.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 24-27 x 18-20, colorless; urediniospores (24-)26-30(-32) x (17-)19-24, golden; teliospores (24-)26-35(-40) x (16-)18-24(-25), golden brown. Distribution: Arizona on *S. torreyana* Wats.

TALINUM (Portulacaceae)

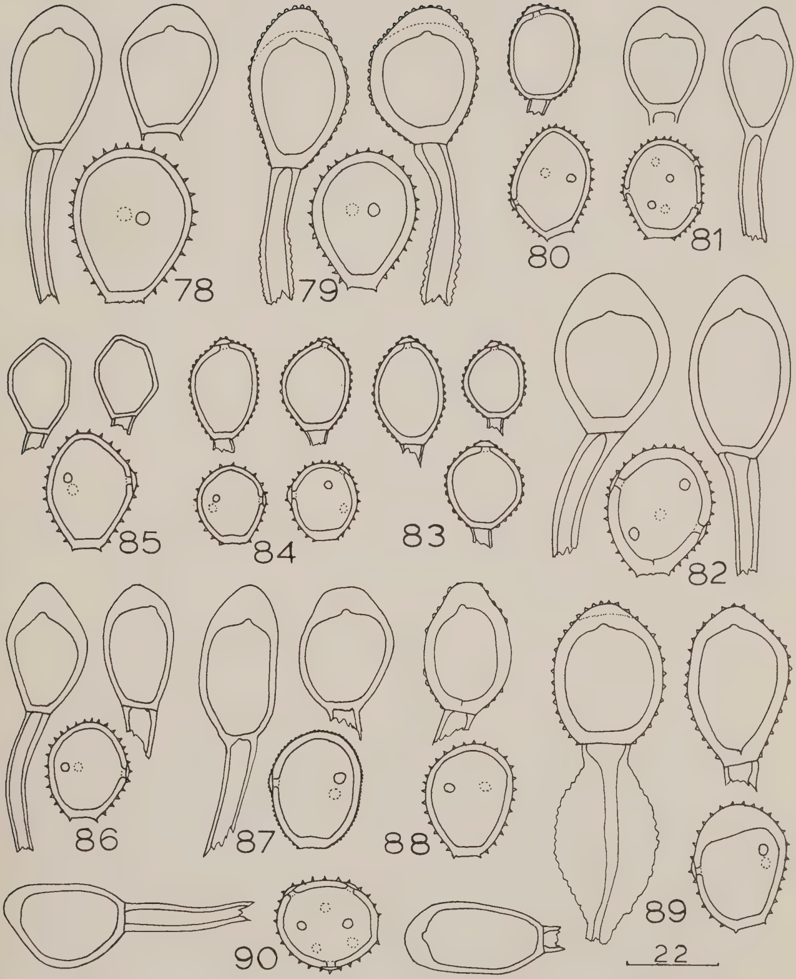
Puccinia leptochloae aecial stage, see *Leptochloa*.

TECOMA (Bignoniaceae)

Prospodium appendiculatum (Wint.) Arth. Fig. 74.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores 24-34 x 21-26, brown; urediniospores 21-26 x 15-18, brown; teliospores 39-55 x 23-32, dark brown. Distribution: Baja California Sur on *T. stans* (L.) Juss.

TEPHROSIA (Leguminosae)

Ravenelia epiphylla (Schw.) Diet. Fig. 11.
Life cycle macrocyclic, autoecious. Aecia uredinoid, aeciospores as the urediniospores; urediniospores (23-)27-33(-38) x (17-)19-22(-24), golden; teliospore heads (75-)80-125(-140) diam, 5-8(9) cells across, brown. Distribution: Sonora on *T. purpurea* (L.) Pers.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Figures 78-91. Species of *Uromyces;* teliospores and urediniospores. 78. *U. compactus*. 79. *U. beloperones*. 80. *U. punctatus*. 81. *U. eragrostidis*. 82. *U. intricatus*. 83. *U. tranzschelii*. 84. *U. euphorbiae*. 85. *U. setariae-italicae*. 86. *U. indigoferae*. 87. *U. limonii*. 88. *U. appendiculatus*. 89. *U. sonorensis*. 90. *U. giganteus*.

TETRAMERIUM (Acanthaceae)

Puccinia tetramerii Seym. Fig. 64.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 20-26 x 18-22, colorless; urediniospores (22-)24-28(-30) x (17-)19-23(-24), brown; teliospores (33-)38-44(-57) x (23-)26-30(-33), dark brown. Distribution: Arizona and Sonora on *Dicliptera resupinata* (Vahl) Juss., *Jacobinia mexicana* Seem., *T. hispidum* Nees. Some host identities uncertain.

TITHONIA (Compositae)

Puccinia enceliae Diet. & Holw. Fig. 72.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores 18-24(-27) x (13-)16-21(-23), colorless; urediniospores (18-)20-24(-28) x (17-)19-23(-25), brown; teliospores (32)36-46(-52) x (-19-)22-26(-29), brown. Distribution: Arizona and Sonora on *T. thurberi* Gray.

TRITELEIOPSIS see *Dichelostemma*.

TRITICUM (Gramineae)

Puccinia graminis Pers.; see addendum.
Puccinia recondita Roberge ex Desm.; see addendum.

VIGUIERA (Compositae)

Puccinia abrupta Diet. & Holw. Fig. 71.
Life cycle unknown. Urediniospores (18-)20-25(-28) x (16-)18-22(-24), brown; teliospores (30-)35-44(-50) x (21-)26-31(-35), brown. Distribution: Arizona and Sonora on *V. dentata* (Cav.) Spreng. and vars.

Puccinia turgidipes H. S. Jack. Fig. 70.
Life cycle macrocyclic, autoecious. Aecia aecidioid, aeciospores (20-)23-27(-30) x (16-)18-22, colorless; urediniospores (24-)26-31(-33) x (15-)17-25(-28), brown; teliospores (36-)38-44(-48) x (29-)30-35, dark brown. Distribution: Arizona on *V. deltoidea* Gray.

XANTHIUM (Compositae)

Puccinia xanthii Schw. Fig. 73.
Life cycle microcyclic. Teliospores (30-)36-60(-70) x 13-19, brownish. Distribution: Arizona and Sonora on *X. strumarium* L., *X.* sp.

ZEA (Gramineae)

Puccinia sorghi Schw.; see addendum.

ADDENDUM

The following fungi occur occasionally on cultivated plants but are not considered to be elements of the desert flora although they are included in the index: *Puccinia antirrhini* (snapdragon rust), *P. asparagi* (asparagus rust), *P. calcitrapae* var. *centaureae* (safflower rust), *P. convolvuli* (morning-glory rust), *P. graminis* (black stem rust), *P. malvacearum* (hollyhock rust), *P. pelargonii-zonalis* ("geranium" rust), *P. purpurea* (sorghum rust), *P. recondita* (wheat leaf rust), *P. sorghi* (corn rust), *P. tanaceti* var. *tanaceti* (chrysanthemum rust), *Uromyces betae* (beet rust), *U. striatus* (alfalfa rust).

REFERENCES

ARTHUR, J. C. 1907-1927. Order Uredinales. N. Amer. Fl. 7(2-12): 83-848. ARTHUR, J. C. 1934. *Manual of the rusts in United States and Canada.* Purdue Res. Found., Lafayette, IN. 438 p. CUMMINS, G. B. 1971. *The rust fungi of cereals, grasses and bamboos.* Springer-Verlag. New York. 570 p. CUMMINS, G. B. 1978. *Rust fungi on legumes and composites in North America.* Univ. Arizona Press. Tucson. 424. p. SHREVE, F. & WIGGINS, I. 1964. *Vegetation and flora of the Sonoran Desert.* Stanford Univ. Press, Stanford, CA. 2 vol. 1740 p.

MYCOTAXON

Vol. X, No. 1, pp. 21-28 October-December 1979

COMPARATIVE ASCOSPORE MORPHOLOGY OF CERTAIN STRAINS OF ROLLANDINA BY SCANNING ELECTRON MICROSCOPY

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SUMMARY

SEM studies of ascospore morphology of the type strains of *Pseudoarachniotus punctuatus*, *P. marginosporus*, *P. hyalinosporus* and *Narasimhella poonensis* have provided definitive evidence in support of positive relationships for these strains. Justification is given for accepting *P. marginosporus*, *P. punctatus* and *N. poonensis* as synonyms of *Rollandina capitata*. *R. hyalinospora* differs distinctly from *R. capitata* on the sole basis of ascospore morphology. *R. capitata* produces ascospores that are lenticular with a prominent longitudinal rim; *R. hyalinospora* produces spherical to oval ascospores without rims.

INTRODUCTION

Thirumalachar and Mathur (9) established the genus *Narasimhella* for a single isolate from soil in India. They described the species, *N. poonensis*, as producing lenticular, ridged ascospores. Orr and Kuehn (5) examined the type culture and determined that it was a strain of *Pseudoarachniotus marginosporus* Kuehn & Orr described earlier. Arx (2) accepted *N. poonensis* as legitimate and included both *P. marginosporus* and *P. hyalinosporus* Kuehn, Orr & Ghosh in the synonomy. Arx (3) also included this synonomy in his report on genera of fungi sporulating in pure culture. That synonomy is incorrect because two species that differ morphologically are involved.

Roy et al. (8), in studying numerous related isolates, determined that two distinct species were present. They also determined that the two species were of the genus *Rollandina* Pat. For clarification, synonomy of the two species is noted below:

Rollandina capitata Pat. 1905. Bull. Soc. Mycol.France 21.83.

= *Pseudoarachniotus marginosporus* Kuehn & Orr. 1963. Mycopathol. Mycol. Appl. 19:257.

= *Pseudoarachniotus punctatus* Dutta & Ghosh. 1961. Mycologia 56:153.

= *Narasimhella poonensis* Thirum. & Mathur. 1965. Sydowia 20:185.

= *Arachniotus marginosporus* (Kuehn & Orr) Udagawa. 1970. Trans. Mycol. Soc. Japan 10:103.

= *Narasimhella hyalinospora* (Kuehn, Orr & Ghosh) von Arx. 1971. Persoonia 6:374. (in part).

Rollandina hyalinospora (Kuehn, Orr & Ghosh) Roy, Orr, & Ghosh. comb. nov. 1978. *In*, Proceedings of the International Symposium on Taxonomy of Fungi, Madras, India P. 221.

= *Arachniotus hyalinosporus* (Kuehn, Orr & Ghosh) Apinis, 1964. Mycol. Pap. 96:41.

= *Narasimhella hyalinospora* (Kuehn, Orr & Ghosh) von Arx. 1971. Persoonia 6:374. (in part).

Arx (4), however, disagreed with the placement of these species stating that *Rollandina* was a nomen confusum. He also stated that *Rollandina* sensu Apinis (1) is synonymous with *Nannizzia* Stockdale. We have agreed with the latter consideration (6, 8). We do not agree with the placement as given by Arx (2, 3, 4) nor with the synonomy noted for these two species.

The purpose of this communication is to demonstrate that the two species under consideration are distinct and that Scanning Electron Microscopy (SEM) provides an additional technique in studies of morphology for taxonomic purposes.

MATERIALS AND METHODS

Rollandina strains:

0-3237, type strain, *Pseudoarachniotus punctatus* Dutta & Ghosh (= *Rollandina capitata* Pat.)

0-729, type strain, *Pseudoarachniotus marginosporus* Kuehn & Orr (= *Rollandina capitata* Pat.)

0-733, type strain, *Pseudoarachniotus hyalinosporus* Kuehn, Orr & Ghosh (= *Rollandina hyalinospora* (Kuehn, Orr & Ghosh) Roy, Orr & Ghosh)

0-3540, type strain, *Narasimhella poonensis* Thirum. & Mathur (= *Rollandina capitata* Pat.)

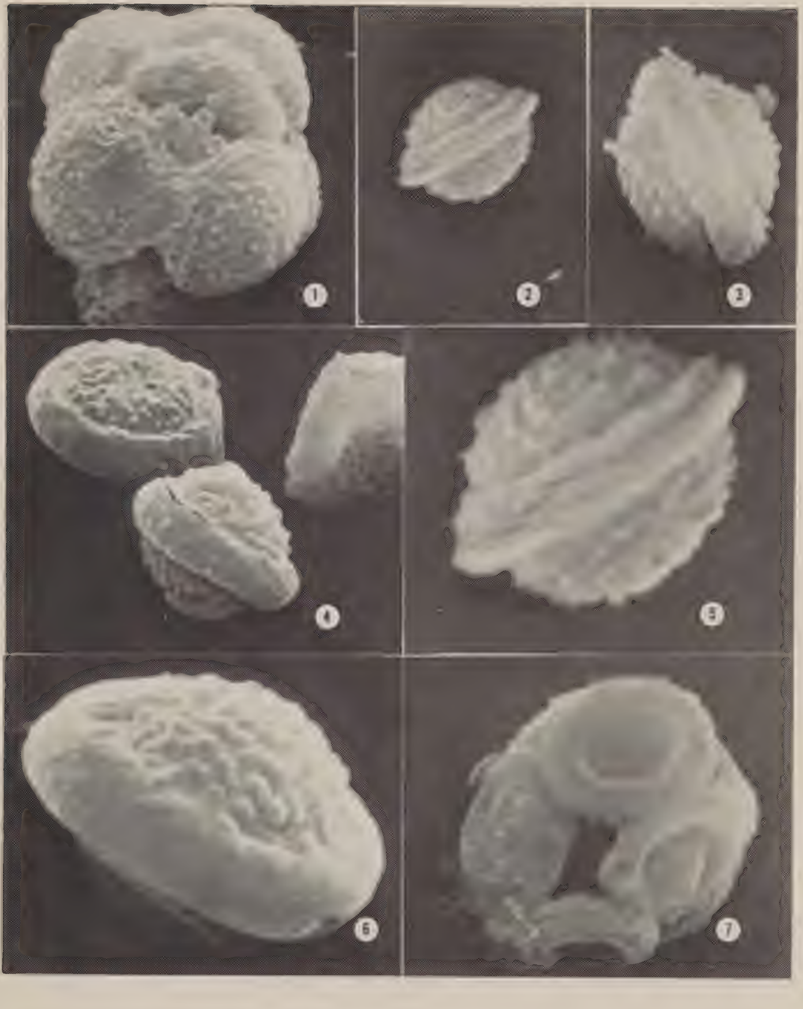
Specimen preparation: Sporulating cultures of the selected strains were prepared for study in the SEM by the method described by Pier et al. (7).

RESULTS AND DISCUSSION

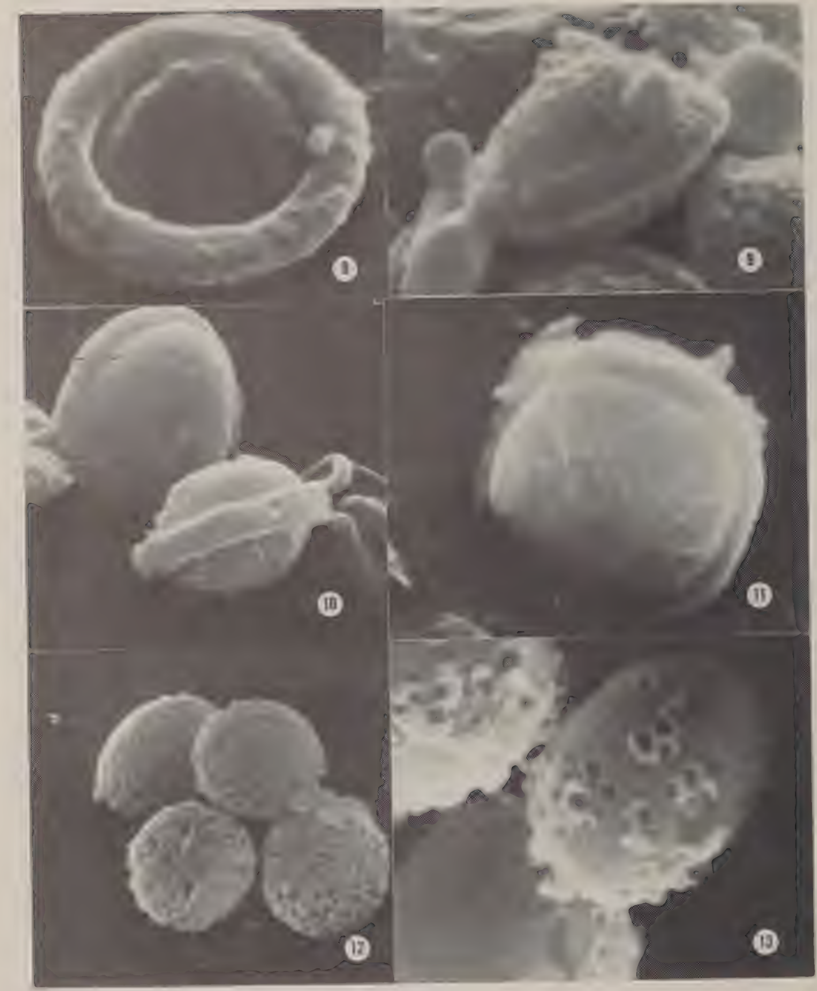
Scanning Electron Microscope (SEM) studies of the ascospore morphology of the type strains of *P. punctatus*, *P. marginosporus*, *P. hyalinosporus* and *N. poonensis* have provided definitive evidence supporting our contention regarding the relationships of these strains. Our observations support the inclusion of *P. marginosporous*, *P. punctatus* and *N. poonensis* as synonyms of *R. capitata*, while *R. hyalinospora* is distinct from *R. capitata* on the sole basis of ascospore morphology. These results are at variance with those of Arx (4) who considered *P. hyalinosporus* similar to *N. poonensis*. The latter has no peridial hyphae, but the ascospores are hyaline to pale yellow with a rim around the longitudinal axis.

The SEM study also confirms previous observations of ascospore morphology for *P. punctatus* (Figs. 1-6). The ovoid to lenticular spores have definite and prominent punctations, often with spine-like protrusions (Figs. 5-6). The longitudinal rim is wide, very distinct and prominent (Figs. 2-4). In the original description of *P. punctatus*, punctations on the outer walls of the ascospores were described, as well as the presence of a prominent rim on the longitudinal axis. Roy et al. (8) stated that the punctations on the ascospores are very difficult to observe with a light microscope and are not satisfactory as a taxonomic character. In this study, the oval to lenticular ascospores of *P. marginosporus* (0-729) appear almost smooth walled and possess a narrow polar rim (Figs. 7-9). In *N. poonensis* (0-3540), the ascospores are similar with an almost smooth surface and a prominent longitudinal rim (Figs. 10-11). This study appears to support our previous observations (5, 8). The presence of deposits may give the appearance of rough spots on the sprore wall (Figs. 10-11). Contrary to the observations of Arx (2), the spores are not "inequilateral lenticular" and the equatorial edge is not fringed. These characteristics apparently suggested a spiny wall to Arx.

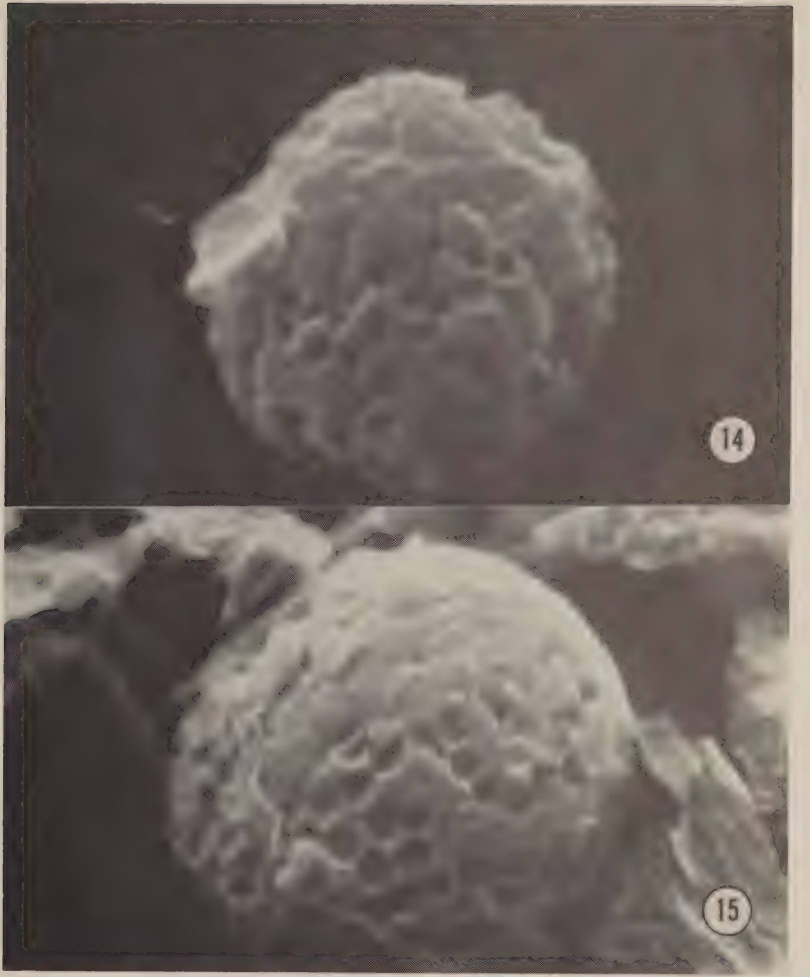
Our SEM studies show that the ascospores of *R. hyalinospora* are almost spherical and their surfaces are pitted rather than smooth. The spores were originally described as smooth-walled. Roy et al. (8) made specific comments on certain strains. In strain 0-287, they noted that the ascospores often appeared roughened due to crystals or other materials laid down on the surface. Figs. 12-15 present evidence that deposits of some kind are present on the spore surface. When the pits are completely covered, the spores may look smooth (Figs. 12-15); when the deposits are removed, the pits are distinct and cause the spore surface to appear roughened or punctuate (Fig. 14). The origin of the pits on the surface of the ascospore walls of *R. hyalinospora* may have originated from small spheres as suggested by the appearance of the wall in Fig. 15. The wall as shown in Fig. 13, however, suggest that vesicles



Figures 1-6. *Pseudoarachniotus punctatus*. Figure 1. Ascocarp cluster. x 9400. Figures 2-4. Ascospores showing longitudinal rim and roughened surfaces. x 8100, x 9400, x 9200. Figures 5-6. Ascospores with spine-like and tubercle-like projections. x 18,000. Figure 7. *Pseudoarachniotus marginosporus*. Ascospore cluster, x 9200 (Figures 2 and 5, same ascospore).



Figures 8-9. *Pseudoarachniotus marginosporus*. Ascospores appear almost smooth-walled with prominent rims. x 10,000, x 9400. Figures 10-11. *Narasimhella poonensis*. Ascospores showing narrow polar rim and nearly smooth surface. x 9000, x 16,000. Figures 12-13. *Pseudoarachniotus hyalinosporus*. Fig. 12. Ascospore cluster. x 8200. Fig. 13. Ascospores showing pitted surface. x 16,000.



Figures 14-15. *Pseudoarachniotus hyalinosporus*. Ascospores showing the pitted surface and deposited material.
x 24,000, x 25,000

were present and had lost their tops. Similar vesiculation as shown in Figs. 8 and 9 were noted by Pier et al. (7) for macroconidia of *Microsporum*. Additional strains with similar rough or punctate surfaces are 0-821, 0-963 and 0-3265.

Arx (2) transferred *P. punctatus* to *Arachniotus*, combining it as *A. punctatus* and stating that it closely resembled *A. dankaliensis* (Cast.) Van Beyma because of the presence of a very prominent equatorial rim around the ascospores in both species. He mentioned the orange coloration of the colony, but overlooked the green coloration of the mature colony. The latter is a distinct diagnostic character for most strains of *Rollandina*. Moreover, the ascospores of *P. roseus* Kuehn (= *A. dankaliensis* (Cast.) Van Beyma) are larger, pale yellow, spherical and banded in surface view (6). Our results do not support the inclusion of *P. punctatus* in *Arachniotus* sensu von Arx nor any relationship with *A. dankaliensis*.

ACKNOWLEDGEMENTS

This work was supported in part by an ARS, USDA Grant authorized by PL-480, Grant No. FG-IN-531, Project No. A7-ADP-43, by the governments of Orissa and India, and in part by a U. S. Army Test and Evaluation Command In-House Independent Research Project No. 7-CO-IL8-DPI-001 through Dugway Proving Ground.

LITERATURE CITED

1. APINIS, A.E. 1964. Revision of British Gymnoascaceae. Mycol. Pap. 96: 1-56.
2. ARX, J.A. VON. 1971. On *Arachniotus* and related genera. Persoonia 6: 371-380.
3. ___. 1974. *The Genera of Fungi Sporulating in Pure Culture*. 2nd. ed. J. Cramer, Vaduz. p. 95.
4. ___. 1977. Notes on Gymnoascaceae. Persoonia 9: 383-400.
5. ORR, G.F., AND H.H. KUEHN. 1971. Notes on Gymnoascaceae. I. A review of eight species. Mycologia 63: 191-203.
6. ___, G.R. GHOSH AND K. ROY. 1977. The genera *Gymnascella*, *Arachniotus* and *Pseudoarachniotus*. Mycologia 79: 126-163.
7. PIER, A.C., K.R. RHOADES, T.L. HAYES AND J. GALLAGHER. 1972. Scanning electron microscopy of selected dermatophytes of veterinary importance. Am. J. Vet. Res. 33: 607-613.
8. ROY, K., G.F. ORR AND G.R. GHOSH. 1978. The genus *Rollandina*. *In* Proceedings of the International Symposium on Taxonomy of Fungi, Part I. Madras, India. Pp 215-244. '1973.'
9. THIRUMALACHAR, M.J. AND P.N. MATHUR. 1966. *Narasimhella*, a new genus of the Gymnoascaceae. Sydowia 20: 184-186.

MYCOTAXON

Vol. X, No. 1, pp. 29-36 October-December 1979

COMPARATIVE PHYSIOLOGY OF SOME STRAINS OF ROLLANDINA[1]

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SUMMARY

A comparative physiological study on four strains of *Rollandina* Pat. was undertaken to ascertain whether or not nutritional parity exists between taxonomically related species and between strains of the same species isolated from saprophytic and clinical sources. The dry weight and quantity of cellular protein produced by the saprophytic strains was greater than that of the clinical strains at their respective peak periods of growth. All the three strains of *Rollandina capitata* behaved alike and differed distinctly from *R. hyalinospora* in their R.N.A. make-up. Results of the 't' test conducted on the D.N.A. content of the mycelia/mg of dry weight indicates that all four fungi belong to the genus *Rollandina*.

On a comparative basis Ghosh (1960) studied the nutritional aspects of six species of Gymnoascaceae with respect to their carbon, nitrogen, vitamin and trace element requirements. She observed that *Ctenomyces serratus* Eidam, *Gymnoascus reessii* Baranetzky, and *Arachniotus reticulatus* Kuehn (= *Amauroascus kuehnii*) (Kuehn) von Arx) had nutritional requirements more similar to those of the Trichophytoneae than to the Aspergillaceae. Other members (*Myxotrichum uncinatum* Eidam (=*Gymnoascus uncinatus* Eidam), and *Penicillium spiculisporum* Lehman demonstrated requirements more similar to the Aspergillaceae than to the Trichophytoneae. She could not, however, present any clear cut physiological evidence which would better support a classification which related the Gymnoascaceae more closely to Aspergillaceae or to the Trichophytoneae than has been suggested by morphological studies. *C. serratus*, *G. reessii* and species of *Amauroascus* Schroeter are keratinophilic and similar nutritional requirements are probable. Several members of the Trichophytoneae are known to produce Gymnoascaceous perfect stages. Strains of Gymnoascaceae isolated from clinical sources have been reported (Orr et al 1977 a, b ; Roy et al 1978). Further more many dermatophytes are geophilic and become "opportunistic" by chance. The aim of the present investigation was to determine whether or not nutritional parity exists between similar taxonomic strains and between strains of the same species isolated from saprophytic and clinical sources.

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[1] Presented at the Second International Mycological Congress, Tampa, Florida, Aug.-Sept, 1977.

The fungi chosen for the present study were *Pseudoarachniotus marginosporus* Kuehn and Orr; *P. punctatus* Dutta and Ghosh; *P. hyalinosporus* Kuehn, Orr & Ghosh and *Narasimhella poonensis* Thirum & Mathur. These are closely related fungi which have posed numerous taxonomic problems. Recently, they have been placed in the genus *Rollandina* by Roy, Ghosh and Orr (1978). A comparative study of their biochemical behaviour and specifically on nitrogen metabolism was undertaken in order to aid in clarifying this taxonomic confusion.

MATERIALS AND METHODS

The strains of *Rollandina capitata* used in this study were; (i) *Rollandina capitata* Pat. (GR-6, O-112), isolated from cat dung, Jagatsingpur, Cuttack, Orissa, India (= type strains of *Pseudoarachniotus marginosporous* Kuehn and Orr 1963); (ii) *Rollandina capitata* (GR-29, O-962, STM F 223), isolated from a *Tinea corporis* lesion of a male patient at the School of Tropical Medicine, Calcutta (= type strain of *Pseudoarachniotus punctatus* Dutta and Ghosh, 1964); (iii) *Rollandina capitata* Pat. (GR-42, O-3540), isolated from soil in Poona, India (=type strain of *Narasimhella poonesis* Thirum and Mathur, 1965); (iv) *Rollandina hyalinospora* (Kuehn, Orr & Ghosh) Roy, Orr and Ghosh (GR-52, O-1247, STM F 231), isolated from a ring-worm lesion of a human male patient at the School of Tropical Medicine, Calcutta, India (= type strain of *Pseudoarachniotus hyalinosporous* Kuehn, Orr & Ghosh, 1961).

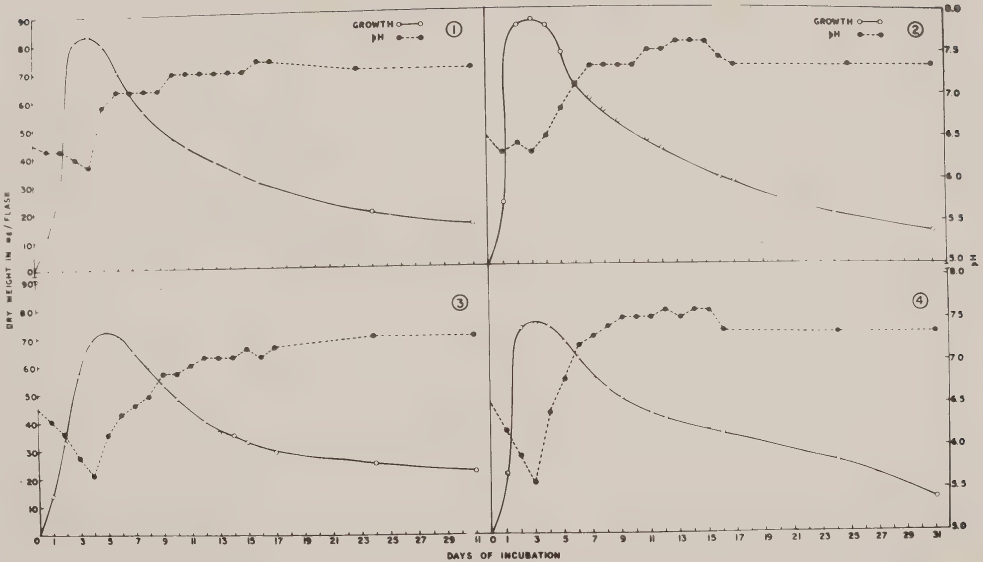
Glucose-asparagine liquid medium of Lilly & Barnett (1951) with pH adjusted to 6.5 was used as the basal medium throughout this investigation. Experimental procedures of Ghosh (1960) were followed. Growth was recorded up to 31 days of incubation according to the technique of Kashyap et al (1972). The pH of the culture filtrates was recorded immediately after filtration in each case. Based on the growth profiles thus obtained, five growth phases on the 1st, 3rd, 5th, 7th and 9th days were chosen for analytical studies.

Fresh mycelia harvested at different phases of growth were processed for separation of the macromolecules according to Schneider (1945). The macromolecules were precipitated in the homogenate by 10% TCA, RNA hydrolysis was accomplished by a modification of the Schmidt and Thannauser method (1945). RNA, DNA and proteins thus separated were quantified by various colorimetric reactions. The protein concentration was measured employing Folin-Ciocalteu reaction of Lowry et al (1951); RNA content was determined by Orcinol method of Ceriotti (1955); DNA content was assayed by Dische's method (1930).

RESULTS AND DISCUSSION

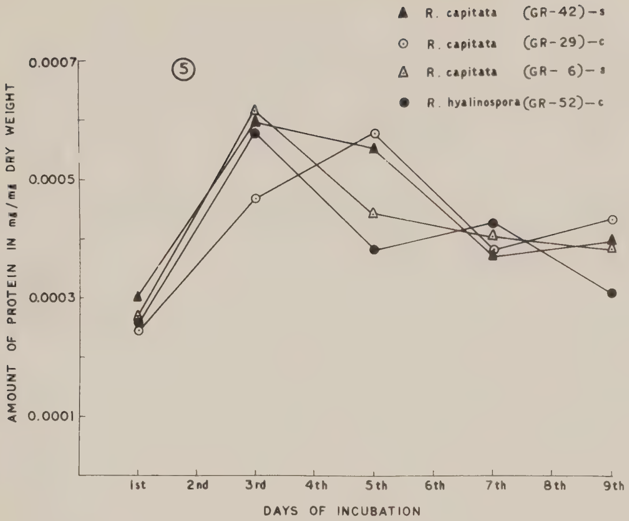
The growth profiles of GR-6 (saprophytic) and GR-52 (clinical) are similar (Figs.2&4), with maximum growth on the 3rd day. However GR-29 (clinical) resembles GR-42 (saprophytic) in demonstrating a slower growth rate (Figs.3&1). All the four profiles were similar in lacking a lag phase. Some differences were observed between the behaviour of the saprophytic and the clinical strains : (a) the dry weights of saprophytic strains were greater than the clinical strains at their respective maximum growth phases. (b) A sudden drop of pH was observed in clinical strains while the drop was gradual in saprophytic strains. In general, the pH demonstrated a decline value as growth proceeded and drifted to alkalinity during autolysis (Figs.1-4).

It was observed that the cellular protein contents increased in all four isolates during their active growth phase and decreased during autolysis (Fig.5). The quantities of cellular protein in the saprophytic strains were greater than in the clinical strains at their respective peak periods of growth. Increase in cellular protein is apparently similar to the increase in dry weights (Figs.1-4). Readings indicate that the protein make-up of the saprophytic strains was greater than that of the clinical ones. It appears that the saprophytic strains may be better adapted in nature than the clinical strains. The pattern of cellular protein synthesis, however, was similar in all the four fungi tested.



Figs.1-4. Growth profiles in glucose-asparagine medium.

1. *Rollandina capitata*, GR-42, Saprophytic
2. *R. capitata*, GR-6, Saprophytic
3. *R. capitata*, GR-29, Clinical
4. *R. hyalinospora*, GR-52, Clinical



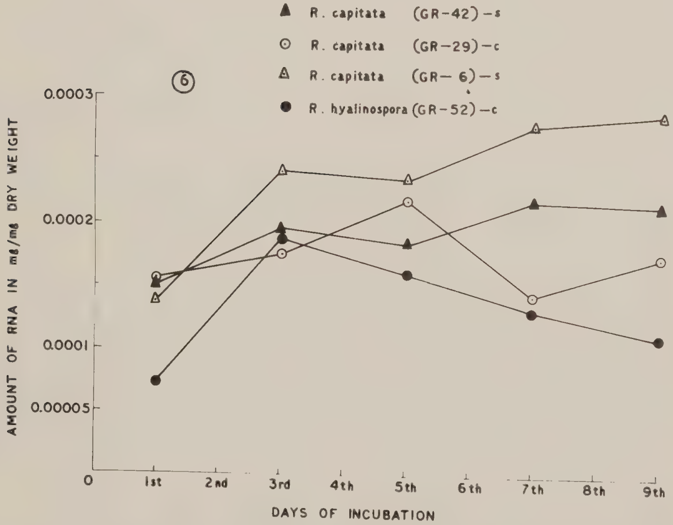


Fig.5. Change in protein content from mycelia at different stages of growth.

Fig.6. Change in R.N.A. content from mycelia at different stages of growth.

The quantity of RNA per mg of dry weight of mycelia increased up to the 3rd day of growth in strains GR-6, GR-42 and GR-52 (Fig.6) while in strain GR-29 the increase continued until the 5th day of incubation. Respective growth curves are similar (Figs.1-4). The increase in RNA content during active growth period of all four fungi indicates that active protein synthesis is occurring. After production of the maximum amount of RNA on the 3rd day (GR-6, GR-42 and GR-52) and 5th day (GR-29), a decline in RNA content/mg dry weight of mycelia was observed (Fig.6). This decline corresponded with the drop in the mycelial dry weights and cellular protein content of each of the four strains (Figs.1-4). This decline in RNA content suggests that protein synthesis was affected with the onset of autolysis. It is interesting to note that the two saprophytic strains of R. capitata (GR-6 and GR-42) demonstrated an increase in RNA content after the 5th day of incubation. In the clinical strain of R.capitata (GR-29) however, RNA content continued to increase until the 7th day of incubation. It appears that during autolysis simultaneous synthesis of cellular proteins occurred.

R. hyalinospora (GR-52) differed from the above three strains in demonstrating a continuous and steady drop of RNA content after the 3rd day of incubation. The curve shown in Fig.6 indicates that protein synthesis was occurring in spite of autolysis. Thus, the metabolic utilization of RNA in the mycelia occurred rapidly during growth.

Results recorded in Fig.6 show that three strains of Rollandina capitata (GR-6, GR-29 and GR-42) behaved alike and differed distinctly from R. hyalinospora (GR-52) in their RNA make-up during growth.

The quantity of DNA/mg dry weight of mycelia of the four fungal strains was also analysed at the five stages of growth. The values obtained are compared in Table I.

For comparative purposes the 't' test was performed with following results. The calculated 't' value for the means of GR-6 and GR-42 is 1.16; for GR-6 and GR-29 is 1.182; for GR-29 and GR-42, the value is 2.626; for GR-6 and GR-52 it is 0.84; for GR-42 and GR-52 the 't' value is 1.53 and for GR-52 and GR-29 it is 2.41.

From these values it can be concluded that the quantities of DNA in GR-6 and GR-42 and GR-6 and GR-29 are not significantly different at the 0.05 level. Though the 't' value for GR-29 and GR-42 at the 0.05 level is marginally significant, yet at the 0.01 level the value is not significant. Moreover, as discussed above, these two strains have shown similarities in their biochemical

TABLE - I

Comparison of total DNA contents in *R. capitata* and *R. hyalinospora*

(All values are in mg per mg of dry weight of mycelia)

Days of incubation	*R.capitata*			*R.hyalinospora*
	(GR-42)	(GR-29)	(GR-6)	(GR-52)
1st	0.0002205	0.0000692	0.000106	0.000048
3rd	0.000144	0.000156	0.000159	0.000169
5th	0.000128	0.000102	0.000156	0.000176
7th	0.000157	0.00011	0.000139	0.000104
9th	0.000174	0.00011	0.000155	0.000110
*	0.0001647	0.0001094	0.000143	0.0001214
	±	±	±	±
	0.0000158	0.0000138	0.0000098	0.000024

* Mean ± S.E.M.

behaviour analysed during this investigation. On the basis of like biochemical behaviour of GR-29 and GR-42 the marginally significant 't' value at the 0.05 level can be overlooked and possibly be attributed to strain variation. The results suggest that GR-6, GR-29 and GR-42 are merely strains of the same species and are not different species.

From the calculated 't' value of the means of the DNA quantities it can be concluded that strain GR-52 (*Rollandina hyalinospora*) is closely allied to the strains GR-6 and GR-42 (*R. capitata*) but the value differs slightly for strain GR-29 (*R. capitata*) at the 0.05 level and insignificantly at the 0.01 level. This close affinity of *R. capitata* and *R. hyalinospora* based on the calculated 't' values of the means would indicate that they originated from the same genetic stock and represent species of the same genus.

ACKNOWLEDGEMENT

The authors wish to thank Dr.M.V.Ramji of Regional College of Education, Bhubaneswar, Orissa, India for the photographic work and Prof. M.C.Das of Sambalpur University for critical suggestions.

The work was supported by an ARS, USDA grant authorised by PL-480, grant no.FG-IN-531, Project A7-ADP-43, and by the Governments of Orissa and India.

REFERENCES

1. CERIOTTI, G. 1955. Determination of nucleic acids in animal tissues. J.Biol.Chem. 214:59-70.

2. DISCHE, Z. 1930. Estimation of DNA. Microchemie. 8:4.

3. GHOSH, G.R. 1960. Comparative physiology of some representatives of the Gymnoascaceae. Mycopathol. Mycol. Appl. 13:161-180.

4. KASHYAP, R.S., S.B.Biswas, and G.R.Ghosh. 1972. Nitrogen metabolism of Arachniotus dankaliensis in submerged culture. Mycologia. 64:727-736.

5. LILLY, VIRGIL G., and H.L.Barnett. 1951. Physiology of fungi. McGraw Hill Book Company, New York. 464 p.

6. LOWRY, O.H., N.J.Rosebrough., A.L.Farr, and R.J.Bandal. 1951. Protein estimation with folin-Ciocalteu reagent. J. Biol. Chem. 193:265-272.

7. ORR, G.F., G.R.Ghosh, and K.Roy. 1977a. The Genera Gymnoascella, Arachniotus and Pseudoarachniotus. Mycologia. 69:126-163.

8. ________., K.Roy, and G.R.Ghosh. 1977b. Gymnoascoideus, a new genus of the Gymnoascaceae. Mycotaxon. 5:459-469.

9. ROY, K., G.R.Ghosh and G.F.Orr 1978. The genus Rollandina. In Proceedings of the International Symposium on Taxonomy of Fungi, University of Madras,1973, Part One. 215-224.

10. SCHNEIDER, W.C. 1945. Determination of nucleic acids in tissues by pentose analysis. J.Biol.Chem. 161: 293-304.

11. SCHMIDT, G., and S.J.Thannhauser. 1945. Partition of Phosphorous compounds into DNA, RNA and Phosphoproteins. J.Biol.Chem. 161:83-95.

MYCOTAXON

Vol. X, No. 1, pp. 37-40 October-December 1979

NOTES ON MYCOLOGICAL HISTORY.

II. SOME DISBURSEMENTS OF SCHWEINITZ'S FUNGI.

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The two major mycological publications on North American fungi by Schweinitz (1822, 1832) resulted from his collections and observations in Pennsylvania and North Carolina. Together with some exotic fungi (mostly from Surinam), these North American specimens made up his fungus herbarium, which subsequently became part of the herbarium of the Philadelphia Academy of Natural Sciences. Both during his lifetime and after his death, however, Schweinitz's fungus herbarium was liberally scattered. Shear & Stevens (1917) reported on no less than 14 disbursements of specimens, but provided few details of the transactions. Recently I have been able to read the correspondence between M.J. Berkeley and M.A. Curtis, which has furnished dates and circumstances not previously reported. The purpose of this paper is to document certain disbursements of Schweinitz's fungi in order both to clarify the history of these events, and to indicate the probable present residences of these specimens.

1. Between 6 July and 13 Sept 1824 Schweinitz dispatched a box containing "nearly 1000 Phaenog. & Cryp. for Prof. Hooker" to John Torrey, who forwarded the lot to Hooker in Glasgow (Shear & Stevens, 1921: 217-220). Later, when Hooker became director of the Royal Botanic Gardens at Kew, this cache of Schweinitz specimens became part of the herbarium. It was acknowledged by Berkeley (Berkeley & Curtis, 1856) in the introduction to his "Commentary".

2. Berkeley (ibid.) also mentioned that Torrey presented "us" his collection of Schweinitz specimens. It was Curtis who received this collection (letter from Curtis to Peck, 2.ix.70): "When I commenced the study of these things, Dr. Torrey gave me all his Schweinitzian Fungi, which were of great service."

It must be mentioned, however, that the fungi enumerated in Schweinitz's (1822, 1832) publications were, of course, not the only fungi in his herbarium. Moreover, he kept at least five duplicate specimens of each taxon on hand "in order to send to friends who wish to have them" (letter, Schweinitz to Torrey, 24.vi.1820; Shear & Stevens, 1921).

If such collections which became depleted were augmented with new material, the possibility grows of mixed or incongruous taxa under individual numbers. This, in turn, could account for Berkeley's later comment (letter to Curtis, 29.vi.58): ". . . You cannot conceive what an irksome [task] the going thro' the Schweinitzians is. Scarcely a species named right, and a mass of the greatest trash. It is really quite painful to have to submit such a comment to the public. He seems to have forgotten his own species."

3. Curtis spent a few days in Philadelphia examining Schweinitz material as early as March, 1851, and was allowed permission to liberally split the collections where possible. Afterward, he immediately offered the splits to Berkeley for his comments. "I shall be delighted to have the scraps of Schweinitz fungi however small" (Berkeley to Curtis, 29.iii.51). It was these specimens which formed the cornerstone of Berkeley's enumeration of fungi from herb. Schweinitz. The material was composed, apparently of both unicates and duplicates, and I find no record that the material was returned.

4. After the appearance of Berkeley's paper (Berkeley & Curtis, 1853) on Schweinitz's exotic fungi Curtis apparently intended to send both offprints of the paper and voucher specimens to Fries at Uppsala. Curtis wrote (to Berkeley, 30.iii.53): ". . . as I shall soon send Boxes to Geneva & Upsal [sic], I will send copies of the Surinam Fungi to Fries and Duby. I have many specimens of the Fungi to send to Fries, probably more than half the species." Conversely, two months later he sent a box to Berkeley, including twelve copies of "our Fungi Surinamensis. These last did not reach me in season for my parcels to Sweden & Switzerland." Berkeley was to supply Fries and Duby with offprints, but Curtis had already posted the boxes, which, at least in Fries's case, were to contain Schweinitz Surinam specimens. Shear & Stevens (1917) reported that such specimens were in fact in herb. Fries at Uppsala.

5. In February, 1855, Curtis forwarded to Berkeley over 300 specimens "which were incapable of division." First mention of these by Curtis was in a letter (to Berkeley, 9.v.54): "I ought to have sent them before, but last year I forgot it." This surely refers to a box sent Berkeley in July, 1853, in which Berkeley acknowledged "notes on fungi in Schweinitzian herbarium and also . . . the sketches." It may be concluded, therefore, that some Schweinitz material came to Berkeley in mid-1853, and the final, indivisible specimens in early 1855. The entire lot laid the foundation for Berkeley's (Berkeley & Curtis, 1856) "Commentary", only one installment of which was published, that on Basidiomycetes.

Berkeley was critical of the condition of the collection he received, and wrote as much in his manuscript (Berkeley & Curtis, 1856) but he allowed Curtis to change the paper as needed. Curtis replied (3.v.55):

> "You have given me license to 'alter any of your remarks without sample.' This will be sometimes necessary, as in such cases where you mark that the specimens are too imperfect, & the like, which is true only of what we ourselves possess. There sometimes remain in Herb. Schwein. very tolerable specimens, which I could appropriate to myself but a meager fragment. This is however but a small matter, & I shall not materially disturb your writing. I wish, however, to be cautious about publishing to the world the liberality of the Academy to me, lest it provoke to similar applications from others, & the herbarium be subjected to injurious depredations. This has been the case in reference to the Musci & Hepaticae . . . Tulasne has, I know, been stimulated by your success to make enquiries in his own behalf but I am very anxious that no more facilities of this kind be offered, until we get through our work. Besides, there is no member of the Academy who has any knowledge of Fungi, & who could select specimens from the Herbarium, or who would superintend such a process & always leave good specimens. For myself, I conscientiously left the best specimens."

With the final shipment, Curtis twice stipulated that these indivisible specimens be returned to him. Berkeley returned a portion of them in March, 1856 (letter, Berkeley to Curtis, 13.iii.56), and their receipt was acknowledged by Curtis 21.v.56. Berkeley continued his study of Schweinitz fungi, sending "notes on the Pezizae etc. up to Hymenella" 29.iv.58, "the commentary on Schweinitz to the end of Sphaeria" 3.vi.59, and stating (same date) that there were "remaining Schweinitzians" still to be analyzed. In 1860, the American Civil War interrupted correspondence, and the only subsequent mention of Schweinitz fungi was in 1870, when Curtis expressed (letter to Berkeley, 3.xii.70): ". . . that you could devote your leisure hour to working up an American Mycology, or, at least, to completing your review of the Schweinitzian fungi." Indeed, an additional handwritten list of identifications is to be found in the Curtis memorabilia,* but no other publications came from it, to my knowledge.

6. In his final years, Curtis split his specimens, making up sets for Mr. Olney (a correspondent from Rhode Island), bequeathed to Brown University (Snell & Dick, 1953), Prof. Bessey, left to the University of Nebraska, and C.H. Peck, The New York State Museum, Albany. Another set was at least started for a "Dr. Allen of N. York." Apparently, at least in the case of Peck, some Schweinitz specimens were included. In a letter to Peck (2.ix.70), Curtis alluded to them, and sent some after forwarding the bulk of his duplicates. Peck (letter to Curtis, 9.xii.70) acknowledged receipt of them: "It does me good to see spec^{ms} from

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*Southern Historical Collection, University Library, University of North Carolina, Chapel Hill, NC.

the hands of Fries and The Herb^{m} of Schweinitz." These Schweinitz specimens remain with the Peck herbarium in Albany.

7. After Curtis's death, his herbarium was sold to W.G. Farlow at Harvard, and became part of the "Farlow Herbarium", where it is cased separate from all other collections. Included are numerous Schweinitz specimens, both from Salem (Schweinitz's early collections and probably part of the set sent to Torrey, thence to Curtis) and from Bethlehem (probably gleaned from his herbarium directly by Curtis). They are arranged alphabetically with all others in Curtis's collections.

Pennell (1934) has stated: "But the end of the century [since Schweinitz's death] finds Schweinitz's herbarium of fungi kept together, as illustrating his greatest contribution to science." This is not the case, as summarized above, and the student of American mycology has farther to look than Philadelphia.

Literature Cited

Berkeley, M.J. & M.A. Curtis. 1853. Exotic fungi from the Schweinitzian herbarium, principally from Surinam. Jour. Philadelphia Acad. Nat. Sci. II: 277-294.

Berkeley, M.J. & M.A. Curtis. 1856. A commentary on the Synopsis Fungorum in America Boreali media degentium, by L.D. de Schweinitz. Jour. Philadelphia Acad. Nat. Sci. II: 205-224.

Pennell, F.W. 1934. The botanist Schweinitz and his herbarium. Bartonia 16: 1-8.

Schweinitz, L.D. de. 1822. Synopsis fungorum Carolinae superioris secundum observationes Ludovici Davidis de Schweinitz. Schrift. Natur. Ges. Leipzig 1: 20-131.

Schweinitz, L.D. de. 1832. Synopsis fungorum in America Boreali media degentium. Trans. Amer. Phil. Soc. II 4: 41-316.

Shear, C.L. & N.E. Stevens. 1917. Studies of the Schweinitz collections of fungi - II. Distribution and previous studies of authentic specimens. Mycologia 9: 333-344.

Shear, C.L. & N.E. Stevens. 1921. The correspondence of Schweinitz and Torrey. Torrey Bot. Club Mem. 16: 119-300.

Snell, W.H. & E.A. Dick. 1953. The Curtis collection at Brown University. Mycologia 45: 968-970.

[Author's note: Ravenel, perhaps prompted by Curtis, gleaned about 150 Schweinitz specimens on a visit in 1853. These should now reside at Kew, for the Ravenel herbarium was sold to the British Museum after his death (cf. Stevens, N. 1932. Isis 18: 133-149.)]

MYCOTAXON

Vol. X, No. 1, pp. 41-45 October-December 1979

RHYTIDOSPORA AND PTERIDIOSPERMA, GEN. NOV. (MELANOSPORACEAE)[1]

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SUMMARY

Rhytidospora bispora sp. nov. is described and illustrated, from cow dung collected in Mexico, and *R. inordinata* comb. nov. (*Microthecium inordinatum* Malloch & Cain) is proposed. A key to the species of *Rhytidospora* is presented. *Pteridiosperma* gen. nov. is erected for two species of *Microthecium* possessing an unusual ornamentation on the ascospores. The combinations *P. ciliata (M. ciliatum* Udagawa & Takada) and *P. foveolata (M. foveolatum* Udagawa & Horie) are proposed. *M. hypomyces* (von Höhnel) von Höhnel, although somewhat atypical for *Microthecium*, is retained in that genus.

INTRODUCTION

Recently Jeng and Cain (1977) erected *Rhytidospora* based on *R. tetraspora* Jeng & Cain. This genus is essentially characterized by the pale cephalothecoid cleistothecia and the dark wrinkled ascospores. In addition to the type, these authors were aware of a Mexican collection which differed only in the number of ascospores. From further study of this collection, a slightly different structure of the peridial plates was observed as well as somewhat larger ascospores. In view of these differences this collection is being described here as a new species.

Our attention has also been drawn to *Microthecium inordinatum* Malloch & Cain (1972). This taxon was described as possessing wrinkled ascospores and appeared to be somewhat atypical for *Microthecium*. A study of the type material indicated that the fungus would be more naturally placed within *Rhytidospora*.

Microthecium hypomyces (von Höhnel) von Höhnel (1914), originally published by von Höhnel (1907) as *Sphaeroderma hypomyces*, was described by Udagawa and Cain (1969) as possessing wrinkled ascospores. Accordingly, we suspected a relationship with *Rhytidospora*. However, a study

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[1] Supported by grants from the National Sciences and Engineering Research Council of Canada.

of the type revealed a different peridial structure, clavate asci, and not nearly so well defined markings on the spore wall as is found in *Rhytidospora*. It would appear that this species is more closely related to *Microthecium* than to *Rhytidospora* and, for the present, it is better retained in that genus.

In a paper on *Microthecium*, Hawksworth and Udagawa (1977) included *M. foveolatum* Udagawa & Horie. This taxon along with *M. ciliatum* Udagawa & Takada (1974) constitute a rather atypical pair of species. In both taxa the spores are ornamented with longitudinal wing-like ridges, which anastomose to form a reticulum, giving the spore a stellate appearance in section. In *M. ciliatum* the spores are wrinkled while those in *M. foveolatum* are pitted between the ridges. We feel that such ascospore ornamentations are unique enough within the Melanosporaceae, and even the Ascomycota in general, that these two taxa must be segregated into a new genus.

RHYTIDOSPORA

Rhytidospora bispora Krug & Jeng, sp. nov. Figs. 1-4.

Ascocarpia dispersa, superficialia, non ostiolata, globosa, circa 270-330 um diametro crassa, pallide armeniaca, glabra, e peridio membranaceo, translucenti, cephalothecoideo composita. Asci unitunicati, iodo non caerulescentes, irregulariter dispersi, bispori, globosi vel subglobosi, 14-15x10-12 um magni, parietibus tenuibus, evanescentes. Paraphyses nullae. Ascosporae unicellulares, ellipsoideae, 12-14x7-10 um magnae, primum hyalinae, deinde pallide brunneae vel olivaceo-brunneae, maturitate confirmata atro-brunneae, parietibus crassis, rugulosae, foramen germinale in utroque apice exhibentes. Conidia incognita.

HOLOTYPUS: In vaccarum fimo lectus est, apud Cuidad del Maiz, in San Luis Potosi provincia, in finibus reipublicae Mexicanae, 19 Sext. 1960, *Cain*, TRTC 36559. In Torontoensis universitatis Cryptogamarum herbario.

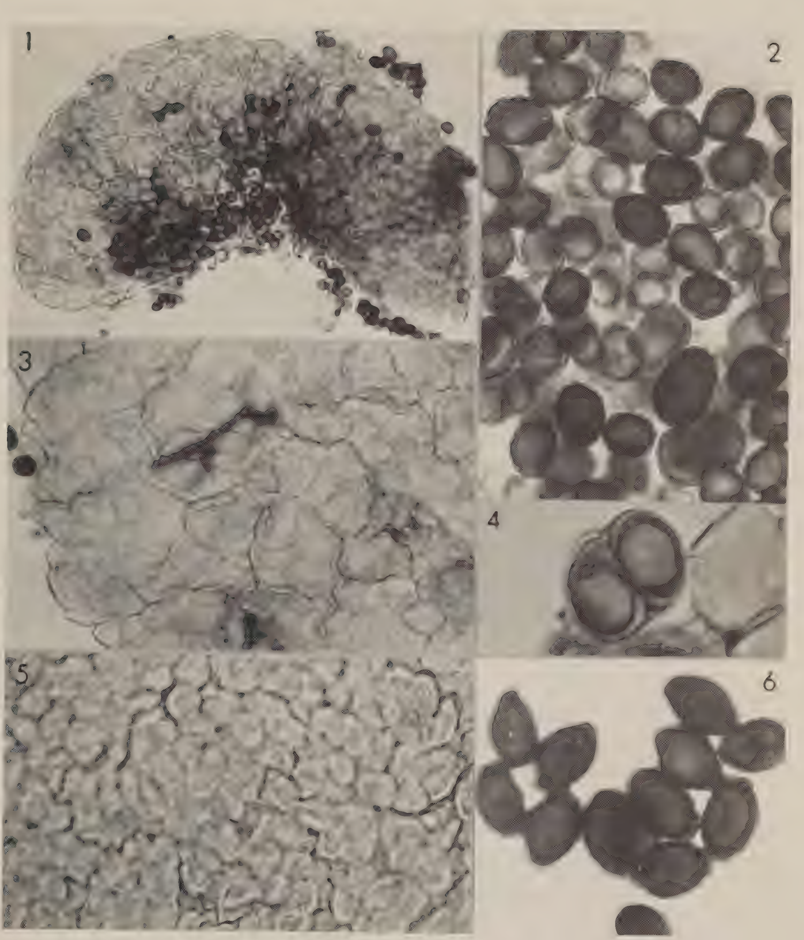
ETYMOLOGY: Latin, *bi* = two and *spora* = seed, referring to the two-spored asci.

Ascocarps scattered, superficial, non-ostiolate, globose, about 270-330 um in diameter, light orange, glabrous; peridium membranaceous, translucent, cephalothecoid in surface view, consisting of a number of regular plates of polygonal, light orange, thin-walled cells measuring 12-24x9-15 um. *Asci* unitunicate, non-amyloid, irregularly disposed, 2-spored, globose to subglobose, 14-15x10-12 um, thin-walled, evanescent. *Paraphyses* lacking. *Ascospores* one-celled, ellipsoidal, 12-14x7-10 um, at first hyaline, ranging in colour from light brown to olivaceous brown, dark brown at maturity, thick-walled, wrinkled, with a germ pore measuring about 1.5 um in diameter at each end of the spore. *Conidia* unknown.

HABITAT: on burro dung.

SPECIMEN EXAMINED: Mexico: San Luis Potosi: Cd. del Maiz, cow dung, 19 Aug. 1960, *Cain*, TRTC 36559 (TRTC).

Unlike *R. tetraspora*, the peridial plate in *R. bispora* is simply



Figs. 1-4. *Rhytidospora bispora*. 1. Ascocarp. x235. 2. Ascospores. x1000. 3. Peridium in surface view, showing the characteristic dehiscence line. x385. 4. Ascus and ascospores. x1600. Figs. 5-6. *Rhytidospora inordinata*. 5. Peridium in surface view, showing the dehiscence line. x450. 6. Ascospores. x1000.

composed of several relatively large, thin-walled cells. These become thick-walled at the periphery of each plate thereby resulting in a continuous dehiscence line.

This relatively simple peridial plate and the two-spored asci are the diagnostic features of the species. It differs from *R. tetraspora* and *R. inordinata* primarily in the number of spores.

Rhytidospora inordinata (Malloch & Cain) Krug & Jeng, comb. nov.
Figs. 5-6
= *Microthecium inordinatum* Malloch & Cain, Can. J. Bot. *50*: 64. 1972.

This taxon was first described and illustrated by Malloch and Cain (1972). In this paper they point out that *M. inordinatum* differs from all other species of *Microthecium* in having irregularly disposed asci, but otherwise it is typical of this genus. However, closer examination reveals that the structure of the peridium and the type of ascospore ornamentation are typical of *Rhytidospora*. According, *M. inordinatum* is transferred to this genus.

The peridium of *R. inordinata* is composed of numerous regular plates, which appear somewhat rugulose or reticulate under low magnification (100x). Upon closer examination each plate was seen to consist of a number of polygonal, thick-walled cells forming a dehiscence line at the periphery. These thick-walled peridial plates and the eight-spored asci are the diagnostic features of the taxon.

Key to the Species

1. Peridial plates composed of radiating and polyhedral
cells; asci 4-spored; ascospores 10-13x7-9 um .. *R. tetraspora*
1. Peridial plates of polyhedral cells only; asci otherwise 2
    2. Asci 2-spored; ascospores 12-14x7-10 um ..... *R. bispora*
    2. Asci 8-spored; ascospores 14.5-18.5x10.5-12.5 um ....
..... *R. inordinata*

PTERIDIOSPERMA

Pteridiosperma Krug & Jeng, gen. nov.

Ascocarpia dispersa, sine stromate nec ostiolo, globosa vel subglobosa, flavo-aurantiaca vel flavo-brunnea, glabra aut tenue pilosa, e peridio membranaceo, luteolo, cellulis polyedricis composita. Asci unitunicati, iodo non caerulescentes, in apice late clavati, fasciculati, evanescentes. Paraphyses nullae. Ascosporae unicellulares, ellipsoideae vel fusiformes, primum hyalinae, maturitate confirmata atrobrunneae vel paene nigrae, rugulosae aut foveolatae, cristas crassas, aliformes, anastomoses, irregulariter reticulatas et foramen germinale in utroque apice exhibentes. Conidiophora erecta, simplicia, breves aut nulla. Phialides singulares, lageniformes, hyalinae. Conidia (phialosporae) unicellularia, hyalina, levia, ovata vel pyriformia, ex apice phialidium in capita, globosa, parva aggregata.

TYPUS GENERIS: *Microthecium foveolatum* Udagawa & Horie.

ETYMOLOGY: Greek, *pteridion*, dim., from *pteros* = wing and *sperma* = seed, referring to the wing-like ridges on the ascospores.

Ascocarps scattered, non-stromatic, non-ostiolate, globose to subglobose, yellowish orange to yellowish brown, glabrous or finely hairy; peridium membranaceous, pale yellowish, composed of polyhedral cells.

Asci unitunicate, non-amyloid, broadly clavate, arising in fascicles, evanescent. *Paraphyses* lacking. *Ascospores* one-celled, ellipsoidal to fusiform, at first hyaline, dark brown to nearly black at maturity, ornamented with thick, wing-like ridges frequently anastomosing to form an irregular reticulum, stellate in section, wrinkled or pitted in convex surfaces, with two germ pores. *Conidiophores* lacking or when present erect, simple, short. *Phialides* borne singly on aerial hyphae or rarely on conidiophores, lageniform, hyaline. *Conidia* (phialospores) one-celled, hyaline, smooth, ovate to pyriform, aggregated in small globose heads at the apices of phialides.

The essential distinguishing features of the genus are the ascospores, which are ornamented with longitudinal, wing-like ridges that often anastomose to form an irregular reticulum. This type of ornamentation reminds one of *Emericellopsis* van Beyma (Pseudeurotiaceae), but that genus differs in the type of peridium, asci, absence of germ pores and the *Acremonium* conidial state. Such fundamental differences clearly differentiate *Pteridiosperma*, a member of the Melanosporaceae, from *Emericellopsis*.

New Combinations

Pteridiosperma ciliata (Udagawa & Takada) Krug & Jeng, comb. nov.

= *Microthecium ciliatum* Udagawa & Takada, Trans. Mycol. Soc. Japan *15:* 23. 1974.

Pteridiosperma foveolata (Udagawa & Horie) Krug & Jeng, comb. nov.

= *Microthecium foveolatum* Udagawa & Horie, Trans. Mycol. Soc. Japan *18:* 149. 1977.

LITERATURE CITED

Hawksworth, D.L. and S. Udagawa. 1977. Contributions to a monograph of *Microthecium*. Trans. Mycol. Soc. Japan *18:*143-154.

Jeng, R.S. and R.F. Cain. 1977. *Rhytidospora*, a new cleistocarpous genus of the Melanosporaceae. Mycotaxon *5:*278-282.

Höhnel, F. von. 1907. Fragmente zur Mykologie. III Mitteilung, Nr. 92 bis 155. Sitzungsber. Kais. Akad. Wissensch. Wien, Mathem.-naturw. Klasse *116:*83-162.

______________. 1914. Fragmente zur Mykologie. XVI Mitteilung, Nr. 813 bis 875. Sitzungsber. Kais. Akad. Wissensch. Wien, Mathem.-naturw. Klasse *123:*49-155.

Malloch, D. and R.F. Cain. 1972. New species and combinations of cleistothecial Ascomycetes. Can. J. Bot. *50:*61-72.

Udagawa, S. and R.F. Cain. 1969. Notes on the genus *Microthecium*. Can. J. Bot. *47:*1915-1933.

____________ and M. Takada. 1974. Notes on some Japanese Ascomycetes XI. Trans. Mycol. Soc. Japan *15:*23-29.

MYCOTAXON

Vol. X, No. 1, pp. 46-48 October-December 1979

PHYSALACRIA SUBPELTATA SP. NOV. FROM HAWAII

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Dried senescent monocot leaves from the Oahu dump in Hawaii were remoistened and incubated at room temperature at the University of British Columbia. One of a number of minute basidiomycetes which sporulated on these leaves was a species of *Physalacria* which appeared to be undescribed. After consulting a number of mycologists familiar with tropical basidiomycetes (G.E. Baker, E.J.H. Corner, R.W.G. Dennis, D. Reid and R. Singer) I have decided that it is unnamed.

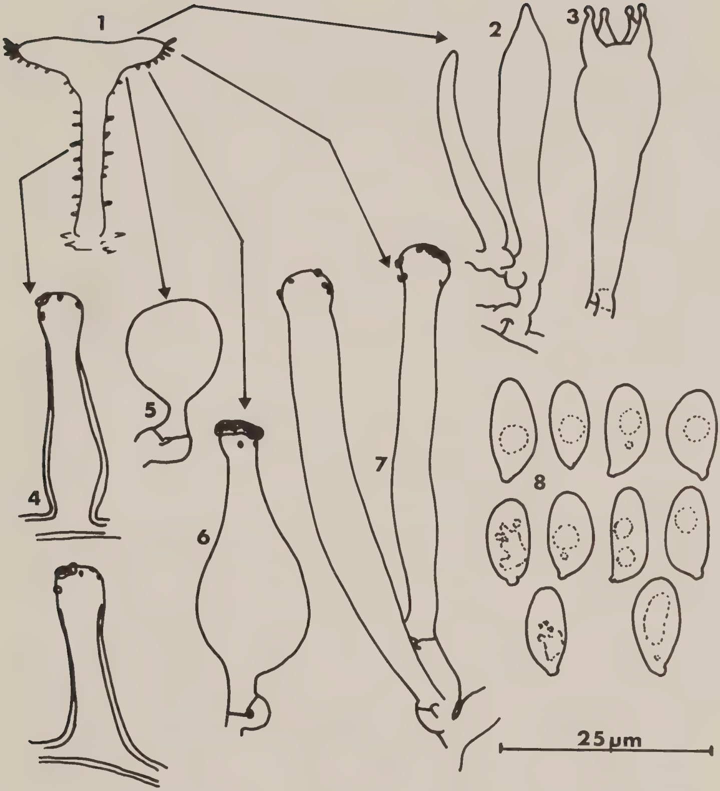
Physalacria subpeltata Redhead, sp. nov. Figs. 1-9

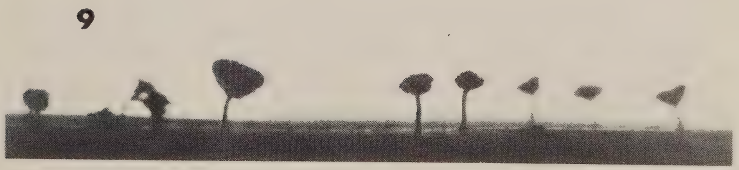
Capitula disciformia, alba, solide, 0.5-1.25 *mm diam., margine puberula. Pseudostipes usque ad* 1 *mm alti, albi, puberuli. Hyphae fibulatae. Hymenia laevia epigena. Cystidia caulis fimbriaeque, capitata, resinacea, usque ad* 50 *μm alti,* 4-5 *μm diam. Basidia* (2)-4 *sporis,* 32-33 x 9-9.5 *μm. Basidiosporae hyalinae, ovoidea-ellipsoideae,* 10-12.5 x 4.5-5 *μm.*

BASIDIOMES: 1-2 mm high, gregarious superficial on leaf surfaces.

CLAVULA: 0.5-1.25 mm wide, discoid to lense-shaped, centrally stipitate, upper surface fertile, concave to convex, smooth, becoming rugose in time, fringed with minute hairs, fleshy, white and somewhat translucent, becoming reddish brown where handled and on drying. STIPE: up to 1 mm long, 125 μm wide, equal, minutely pubescent, white, becoming pale brown from the base upwards with time, becoming reddish brown on handling, insitutuous.

BASIDIA: subacerose when young, becoming prominently clavate at maturity (2-) or 4-spored, hyaline, 32-37 x 9-9.5 μm; sterigmata 4-5 μm long. CYSTIDIOLES: abundant, narrowly mucronate-clavate, 32-34 x 4-7 μm. BASIDIOSPORES: ellipsoid to ovoid, 10-12.5 x 4.5-5 μm, hyaline, white in mass, smooth, thin-walled, nonamyloid, inequilateral, 1-2-guttulate. CYSTIDIA: marginal oleocystidia longer than other forms, up to 50 μm long, 4-5 μm diam., cylindrical or elongate-fusoid, capitate, exuding a hyaline resin-like incrustation on the apex which becomes reddish brown in ammonia solution but dissolves in KOH solution; intergrading with





Figs. 1-9. *Physalacria subpeltata* (type collection). 1. Diagramatic outline of a magnified basidiome with arrows indicating the relative positions of the following. 2. Basidioles. 3. Basidium. 4. Caulocystidia. 5-7. Sterile elements on the capitulum. 8. Basidiospores. 9. Fresh basidiomes on a leaf surface silhouetted by back lighting (X ca. 5).

sphaeropedunculate cells and broadly capitate-ventricose oleocystidia on the abhymenial surface, up to 18 µm diam.; caulocystidia similar to the marginal oleocystidia but shorter, often thick-walled and often not subtended by a septum, up to 40 µm long. HYPHAE: loosely interwoven and thin-walled in the clavula, clamped, 4-6 µm diam., smooth, parallel and with pronounced walls in the stipe, hyaline but becoming pale brown from the stipe base upwards with age.
HOLOTYPUS: DAOM 189451, on senescent monocot leaves, Aug., 1st. wk., 1972, by G.H.N. Towers. ISOTYPI: K, F, BPI.

The distinctive features of this species are the discoid clavula which are fringed by long capitate oleocystidia and the sterile base. No other species of *Physalacria* has this combination of characters. Apparently a basidiomycetous culture from Hawaii which Dr. Singer had previously examined may have been this species, although the basidiomes formed in Dr. Singer's culture were sterile or nearly so (Singer, personal communication).

The dried basidiomes have a reddish brown glazed appearance due mainly to the discoloured, hardened resin from the cystidia. When fresh the resin readily dissolved in KOH solution but after hardening it resisted dissolution. Multiple spore isolates were obtained on malt agar, and grew well at 20°C. Irregular basidiomes were produced on the inoculating blocks in subcultures. These basidiomes were initially short-stalked but soon became sessile convoluted and brain-like masses. Often the stalks were forked, no oleocystidia were formed and sterile patches of hyphal ends were frequently produced on this mass. All of these indicated abnormal development. Unfortunately this culture has since been lost.

Singer (1976: 302, 311) made this species the type for *Physalacria* sect. *Pileolina*.

The assistance of Drs. D.B.O. Savile, J. Ginns, R. Singer and R.A. Shoemaker is gratefully acknowledged in addition to those consulted earlier.

LITERATURE CITED

Singer, R. 1976. Marasmieae (Basidiomycetes - Tricholomataceae). Flora Neotropica. Monogr. 17: 1-347, N.Y. Bot. Gard., Bronx.

MYCOTAXON

Vol. X, No. 1, pp. 49-92 October-December 1979

INDEXES TO W. G. SOLHEIM'S MYCOFLORA SAXIMONTANENSIS EXSICCATA[1]

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Over a period of 45 years Wilhelm G. (Bill) Solheim issued 17 centuries of his Mycoflora Saximontanensis Exsiccata. The first 15 schedae accompanying these sets were published in the University of Wyoming Publications and the last two in Mycotaxon. These indexes are presented to make this monumental contribution to knowledge of Rocky Mountain fungi more readily available to mycologists throughout the world.

Bill Solheim was above all an out-of-doors mycologist, a field man, a collector and, incidentally, an avid fisherman. Often, his co-collector was Ragnhild, his wife. There is no record, but he must have logged several thousand miles on foot in the Rocky Mountain states. We were privileged, in his later years, to accompany Bill on collecting trips in southern Arizona. The privilege entailed hard work; he was a rugged man still. The exsiccata set ended with No. 1700. The number looks simple, but represents only part of his collections, the part that he could gather in good condition and in quantities sufficient to assemble 25 or more sets. Number 1 is *Albugo bliti*, collected in 1931; No. 1700 is *Uromyces viciae-fabae*, and most intervening numbers also represent parasites. The latest Solheim collections included in the Mycoflora were made in 1974 by W. G. and Ragnhild. Bill's last collection probably was made the last day that he was able to get out of his home. The Mycoflora is an appropriate monument to a dedicated mycologist and an admirable gentleman.

The 17 centuries were published as follows:

I(1-100); University of Wyoming Publications in Science (Botany) 1(8):219-232. 1934.		
II(101-200); University of Wyoming Publications 3(3):89-99. 1937.		
III(201-300)	"	7(3):29-42. 1940.
IV(301-400)	"	10(4):33-46. 1943.
V(401-500)	"	15(1):1-27. 1950.
VI(501-600)	"	18(2):71-82. 1954.
VII(601-700)	"	21(4):142-155. 1957.
VIII(701-800)	"	21(5):156-167. 1957.
IX(801-900)	"	23(3):23-37. 1959.

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[1] University of Arizona Agricultural Experiment Station Journal article no. 2988.

X(901-1000); University of Wyoming Publications 23(4):38-51. 1959.
XI(1001-1100) " 24(3):22-33. 1960.
XII(1101-1200) " 24(4):34-55. 1960.
XIII(1201-1300) " 36(3):37-50. 1970.
XIV(1301-1400) " 36(4):51-67. 1970.
XV(1401-1500) " 36(5):69-80. 1970.
XVI(1501-1600); Mycotaxon 8(2):385-394. 1979.
XVII(1601-1700); Mycotaxon 8(2):395-401. 1979.

The index to fungi gives the exsiccati number, state where collected, literature citation, and host, respectively, for each specimen. Abbreviations for states are those of the U.S. Postal Service as follows: AZ, Arizona; CO, Colorado; ID, Idaho; NM, New Mexico; NV, Nevada; MT, Montana; UT, Utah, and WY, Wyoming. Abbreviations for Canadian provinces are AT, Alberta and BC, British Columbia. The host index lists only the fungus species represented on each host plant. Varietal names are not included in the indexes. Authorities for names have been omitted to conserve space. All literature citations refer to the University of Wyoming Publications except those preceded by M, which are in Mycotaxon.

INDEX TO FUNGI

ABSIDIA SPINOSA 1302 WY 36(4):51 on Comandra pallida.
ADELOPUS BALSAMICOLA 210 WY 7(3):30 on Abies lasiocarpa.
AECIDIUM SP. 172 WY 3(3):95 on Valeriana ceratophylla.
AECIDIUM MIRABILIS 926 AZ 23(4):41 on Mirabilis longiflora.
ALBUGO BLITI 601 WY 21(4):142 on Amaranthus graecizans; 1 CO 1(8):219, 486 CO 15(1):23, 602 WY 15(1):23 on A. retroflexus.
ALBUGO CANDIDA 1104 WY 24(4):35 on Capsella bursa-pastoris; 1501 AZ M8 (2):386 on Descurainia pinnata; 1105 WY 24(4):35 on D. sophia; 202 WY 7(3):29 on Draba nemorosa; 1106 WY 24(4):35, 1303 WY 36(4):52 on Lepidium densiflorum; 1304 WY 36(4):52 on Raphanus sativa; 32 WY 1 (8):223, 2 WY 1(8):219 on Sisymbrium linifolium; 1107 WY 1(8):223, 1305 WY 1(8):223 on S. altissimum; 1306 AZ 1(8):223 on S. irio.
ALBUGO OCCIDENTALIS 101 WY 3(3):89 on Chenopodium capitatum.
ALBUGO PLATENSIS 401 AZ 15(1):1 on Boerhaavia sp.
ALBUGO TRAGOPOGONIS 1307 AZ 36(4):52 on Ambrosia confertifolia; 1108 WY 24(4):35 on Matricaria matricarioides, 603 WY 21(4):142 on Tragopogon porrifolius.
ALTERNARIA HERCULEA 99 CO 1(8):232 on Brassica rapa.
ALTERNARIA TENUIS 1573 AZ M8(2):392 on Oenothera primiveris.
AMANITA MUSCARIA 376 CO 10(4):41 on ground.
AMPHISPHAERIA SEPARANS 28 CO 1(8):222 on Populus angustifolia.
ANTHOSTOMELLA RATIBIDAE 428 NM 15(1):6 on Ratibida tagetes.
APIOSPORELLA ALPINA 429 WY 15(1):7 on Pedicularis bracteosa.
APIOSPORINA COLLINSII 1329 WY 36(4):55 on Amelanchier alnifolia.
ARMILLARIA MELLEA 377 CO 10(4):41 on Populus tremuloides.
ARTHROCOIDEA ELEOCHARIDIS 1345 WY 36(4):57 on Carex simulata.
ASCOCHYTA THERMOPSIDIS 84 WY 1(8):229 on Thermopsis divaricarpa.
ASCOCHYTA UTAHENSIS 469 CO 15(1):16 on Agropyron inerme.
ASPERISPORIUM PEUCEDANI 499 ID 15(1):26 on Lomatium nudicaule.
ASTEROMA TENNERIMUM 82 WY 1(8):228 on Erythronium parviflorum.
AURICULARIA AURICULA-JUDAE 346 CO 10(4):38, 1151 WY 24(3):28 on wood.
BASIDIOPHORA ENTOSPORA 1502 WY M8(2):386 on Aster chilensis.

BIFUSELLA LINEARIS 1331 CO 36(4):56 on Pinus flexilis.
BIFUSELLA PINI 1332 NV 36(4):56 on Pinus monophylla.
BIFUSELLA SACCATA 1333 CO 36(4):56 on Pinus flexilis.
BOLETUS EDULIS 374 CO 10(4):40 on ground.
BOLETUS VERSIPELLIS 375 CO 10(4):41 on ground.
CALDESIA SABINA 104 WY 3(3):2 on Juniperus scopulorum.
CALVATIA CYATHIFORMIS 1555 CO M8(2):390 on ground.
CANTHARELLUS CIBARIUS 378 CO 10(4):41 on ground.
CERCOSEPTORIA CREPIDIS 1190 WY 24(4):51 on Crepis runcinata.
CERCOSEPTORIA RIBIS 1191 WY 24(4):51 on Ribes viscosissimum.
CERCOSEPTORIA VALERIANAE 1192 WY 24(4):52 on Valeriana edulis.
CERCOSPORA BETICOLA 1574 CO M8(2):392, 1575 CO M8(2):392 on Beta vulgaris.
CERCOSPORA CLAVATA 1393 WY 36(4):66 on Asclepias speciosa.
CERCOSPORA FRASERAE 1577 ID M8(2):392 on Swertia radiata; 1576 WY M8(2):392 on Frasera speciosa.
CERCOSPORA GERANII 1578 WY M8(2):392 on Geranium richardsonii; 1579 WY M8(2):392 on G. viscosissimum.
CERCOSPORA ITHACENSIS 1394 WY 36(4):66 on Geranium sp; 1193 WY 24(4): 53, 1580 WY M8(2):392 on G. viscosissimum.
CERCOSPORA MANITOBANA 1395 ID 36(4):67 on Elaeagnus commutata.
CERCOSPORA ROSICOLA 1581 CO M8(2):392 on Rosa sp.
CERCOSPORA SEPTORIOPSIS 1396 WY 36(4):67 on Ribes viscosissimum.
CERCOSPORA SQUALIDULA 1397 WY 36(4):67 on Clematis hirsutissima; 1398 WY 36(4):67 on Clematis ligusticifolia.
CERCOSPORA SYMPHORICARPI 1582 WY M8(2):392 on Symphoricarpos sp.; 1194 WY 24(4):53 on S. vaccinioides.
CERCOSPORA THERMOPSIDIS 1399 WY 36(4):67 on Thermopsis divaricarpa; 1583 WY M8(2):392 on T. rhombifolia.
CHRYSOMYXA ARCTOSTAPHYLI 501 WY 21(5):156, 701 MT 21(5):156, 1601 WY M8(2):395 on Arctostaphylos uva-ursi; 1401 WY 36(5):69 on Picea engelmannii.
CHRYSOMYXA LEDI 502 MT 18(2):71 on Ledum glandulosum.
CHRYSOMYXA LEDICOLA 1602 AT M8(2):395 on Ledum groenlandicum.
CHRYSOMYXA PIROLATA 625 WY 21(4):146, 1001 WY 24(3):22, 1603 WY M8(2): 395 on Pyrola asarifolia; 1604 WY M8(2):395 on P. chlorantha.
CIBORINIA CONFUNDENS 1534 WY M8(2):388 on Populus tremuloides.
CICINNOBOLUS MAJOR 1357 WY 36(4):59 on Erysiphe cichoracearum.
CINTRACTIA CARICIS 131 CO 3(3):92 on Carex sp.; 439 WY 15(1):9 on C. festivella; 436 WY 15(1):9 on C. filifolia; 437 WY 15(1):9 on C. praegracilis; 438 WY 15(1):9 on C. reynoldsii.
CINTRACTIA CARPOPHILA 1139 WY 24(4):40 on Carex vallicola.
CINTRACTIA SUBINCLUSA 212 WY 7(3):30 on Carex rostrata.
CLAVARIA FLAVA 356 CO 10(4):39 on ground.
CLAVARIA PISTILLARIS 357 CO 10(4):39 on ground.
CLAVARIA PURPUREA 358 CO 10(4):39 on ground.
CLAVICEPS PURPUREA 122 WY 3(3):91 on Agropyron dasystachyum; 1344 WY 36(4):57 on A. desertorum; 121 WY 3(3):91 on A. pauciflorum; 24 WY 1(8):222 on A. smithii; 120 WY 3(3):91 on Elymus condensatus; 123 WY 3(3):91 on E. glaucus.
CLITOCYBE INFUNDIBULIFORMIS 379 CO 10(4):41 on ground.
COLEOSPORIUM ASTERUM 702 MT 21(5):156 on Aster conspicuus; 1201 MT 36(3):37 on Solidago missouriensis.
COLEOSPORIUM CROWELLII 313 NM 10(4):35, 901 AZ 23(4):38 on Pinus edulis.
COLEOSPORIUM EUPATORII 902 AZ 23(4):38 on Brickellia californica.

COLEOSPORIUM JONESII 904 AZ 23(4):39, 626 CO 21(4):146 on Pinus edulis; 905 AZ 23(4):39 on Ribes cereum; 903 AZ 23(4):39 on R. inebrians; 627 WY 21(4):146 on R. inerme; 906 AZ 23(4):39 on R. leptanthum; 907 AZ 23(4):39 on R. pinetorum; 314 CO 10(4):35 on R. saxosum; 908 AZ 23(4):39 on R. velutina.

COLEOSPORIUM SOLIDAGINIS 137 WY 3(3):92 on Aster lindleyanus.

COLEOSPORIUM VIGUIERAE 1605 AZ M8(2):395, 1631 AZ M8(2):397 on Viguiera dentata.

COLEROA CHAETOMIUM 427 CO 15(1):6 on Rubus sp.

COLEROA RUBICOLA 1523 AZ M8(2):387 on Rubus strigosus.

CONIOPHORA CORRUGIS 347 WY 10(4):38 on Abies lasiocarpa; 1551 WY M8(2): 390 on Pinus contorta; 348 CO 10(4):38 on P. flexilis; 1550 WY M8(2): 390 on wood.

CONIOTHYRIUM CONCENTRICUM 83 CO 1(8):228 on Yucca glauca.

CORTICIUM BYSSINUM 349 WY 10(4):38 on wood.

CORTINARIUS FLAVIFOLIUS 380 CO 10(4):41 on ground.

CORTINARIUS GLAUCOPOIDES 381 CO 10(4):41 on ground.

CORTINARIUS MUCIFLUUS 382 CO 10(4):41 on ground.

CRANDALLIA JUNCICOLA 303 WY 10(4):33, 386 WY 10(4):42 on Juncus drummondii.

CRONARTIUM COLEOSPORIOIDES 910 AZ 23(4):40 on Castilleja linariaefolia; 703 MT 21(5):156 on C. miniata; 909 AZ 23(4):40 on C. patriotica; 1002 WY 24(3):22 on Pinus contorta; 704 MT 21(5):157 on Rhinanthus kyrollae.

CRONARTIUM COMANDRAE 705 MT 21(5):157, 1005 WY 24(3):23, 1402 WY 36(5):69 on Comandra pallida; 1003 WY 24(3):23, 1004 WY 24(3):23 on Pinus contorta.

CRONARTIUM CONIGENUM 913 AZ 23(4):40 on Pinus chihuahuana; 911 AZ 23(4):40, 1403 AZ 36(5):69 on Quercus emoryi; 912 AZ 23(4):40 on Q. grisea; 914 AZ 23(4):40 on Q. hypoleucoides.

CRONARTIUM OCCIDENTALE 628 WY 21(4):146 on Ribes aureum.

CRONARTIUM PYRIFORME 38 WY 1(8):224 on Comandra pallida.

CUMMINSIELLA MIRABILISSIMA 636 UT 21(4):147, 714 MT 21(5):158, 715 MT 21(5):158, 927 AZ 23(4):42, 1022 ID 24(3):25, 1023 WY 24(3):25, 1217 UT 36(3):39, 1269 WY 36(3):46, 1423 AZ 36(5):72, 1618 WY M8(2):396, 1619 BC M8(2):396, 1620 AZ M8(2):396 on Berberis repens.

CUMMINSIELLA SANGUINEA 227 WY 7(3):32, 513 CO 18(2):72, 514 NM 18(2): 73 on Berberis aquifolium.

CYLINDROSPORIUM BALSAMORHIZAE 1370 WY 36(4):61 on Balsamorhiza sagittata.

CYLINDROSPORIUM CONSERVANS 1568 WY M8(2):391 on Salix lasiandra.

CYLINDROSPORIUM CONSOCIATUM 176 WY 3(3):96, 192 WY 3(3):98, 388 WY 10(4):42, 1371 MT 36(4):62 on Acer glabrum; 690 UT 21(4):153 on A. grandidentatum.

CYLINDROSPORIUM CORNI 488 WY 15(1):23 on Cornus stolonifera.

CYLINDROSPORIUM FILIPENDULAE 1163 WY 24(4):45 on Spiraea splendens.

CYLINDROSPORIUM HERACLEI 1372 WY 36(4):62 on Heracleum lanatum; 1373 WY 36(4):62 on Ligusticum porteri; 389 WY 10(4):42 on L. simulans.

CYLINDROSPORIUM HYDROPHYLLI 1168 WY 24(4):46 on Hydrophyllum capitatum.

CYLINDROSPORIUM MONTENEGRINUM 295 WY 7(3):41 on Trollius albiflorus.

CYLINDROSPORIUM OCULATUM 489 NM 15(1):24 on Populus angustifolia.

CYLINDROSPORIUM SAXIMONTANENSE 490 CO 15(1):24, 491 NM 15(1):24, 691 WY 21(4):153 on Populus angustifolia.

CYLINDROSPORIUM SMILACINAE 1374 WY 36(4):62 on Smilacina stellata.

CYLINDROSPORIUM SPIRAEICOLUM 296 WY 7(3):41 on Spiraea lucida.

CYLINDROSPORIUM TRIFLORI 1164 WY 24(4):45 on Potentilla gracilis.

CYLINDROSPORIUM UMBELLIFERARUM 492 CO 15(1):24 on Heracleum lanatum.
CYLINDROSPORIUM URTICAE 493 WY 15(1):25 on Urtica gracilis.
CYLINDROSPORIUM UTAHENSES 1375 UT 36(4):62 on Betula occidentalis.
CYLINDROSPORIUM VERATRINUM 1376 UT 36(4):63 on Veratrum californicum.
CYLINDROSPORIUM WYETHIAE 1380 ID 36(4):64 on Wyethia amplexicaulis.
CYTOSPORA CHRYSOSPERMA 288 WY 7(3):38 on Populus sp.; 1155 WY 24(4):42 on P. tremuloides; 468 WY 15(1):16 on Salix babylonica.
CYTOSPORA CORNI 1558 CO, 1559 WY M8(2):390 on Cornus stolonifera.
DARLUCA FILUM 1358 AZ 16(4):59 on Cronartium conigenum; 664 WY 21(4):150 on Puccinia substerilis.
DASYSCYPHA ARIDA 403 CO 15(1):1 on wood; 1535, 1536 WY M8(2):388 on Abies lasiocarpa; 1131 WY 24(4):39 on Pinus contorta.
DASYSCYPHA FUSCOSANGUINEA 1537 WY M8(2):388 on Pinus contorta.
DASYSCYPHA OBLONGISPORA 1538 WY M8(2):389 on Pinus contorta.
DIATRYPE ALBOPRUINOSA 621 CO 21(4):145 on Quercus gambelii.
DIBOTRYON MORBOSUM 622 CO 21(4):145 on Prunus virginiana.
DIDYMARIA CLEMATIDIS 494 CO 15(1):25, 1584 WY M8(2):392 on Clematis ligusticifolia.
DIDYMARIA CONFERTA 392 WY 10(4):44, 1167 WY 24(4):46 on Wyethia amplexicaulis.
DIDYMARIA HYDROPHYLLI 1168 WY 24(4):46 on Hydrophyllum capitatum.
DIDYMARIA WYETHIAE 1380 ID 36(4):64 on Wyethia amplexicaulis.
DIDYMOBOTRYOPSIS CERASTII 1200 WY 24(4):54 on Cerastium arvense.
DIDYMOSPHAERIA CLEMENTSII 126 WY 3(3):91 on Yucca glauca.
DIMEROSPORIUM COLLINSII 22 WY 1(8):222 on Amelanchier alnifolia.
DISCELLA PILOSULA 91 CO 1(8):230 on Acer glabrum.
DISCINA ANCILIS 1539 WY M8(2):389 on Pinus contorta.
DOASSANSIA ALISMATIS 1143 ID 24(4):41 on Alisma plantago-aquatica.
DUPLICARIA ACUMINATA 303 WY 10(4):33 on Juncus drummondii.
EMERICELLOPSIS STOLKIAE 1522 WY M8(2):387 on cornmeal agar.
ENDOPHYLLUM TUBERCULATUM 1424 WY 36(5):72 on Althaea rosea; 515 CO 18(2):72 on Sidalcea neomexicana.
ENTYLOMA ARNICALE 447 WY 15(1):10 on Arnica chamissonis; 30 WY 1(8):223 on A. cordifolia; 448 WY 15(1):10 on A. subplumosa.
ENTYLOMA CALENDULAE 1144 WY 24(4):41 on Arnica chamissonis; 1145 WY 24(4):41, 1146 ID 24(4):41 on A. cordifolia; 1147 WY 24(4):41, 1346 WY 36(4):57 on A. mollis; 1148 WY 24(4):41 on Senecio triangularis.
ENTYLOMA COMPOSITARUM 1149 WY 24(4):42, 1347 ID 36(4):57 on Aster foliaceus; 449 WY 15(1):10 on Erigeron salsuginosus; 1150 WY 24(4):42, 1544 WY M8(2):389 on E. speciosus.
ENTYLOMA PHYSALIDIS 31 WY 1(8):223 on Solanum triflorum.
ENTYLOMA SEROTINUM 133 WY 3(3):92 on Mertensia ciliata.
ENTYLOMA VERONICAE 623 WY 21(4):145 on Veronica americana.
ENTYLOMA WINTERI 1545 WY M8(2):389 on Delphinium occidentale.
ENTYLOMA WYOMINGENSE 450 WY 15(1):11 on Delphinium barbeyi.
ERYSIPHE CICHORACEARUM 107 WY 3(3):89 on Ambrosia trifida; 1524 WY M8(2):387 on Aster adscendens; 108 WY 3(3):89 on A. adsurgens; 12 WY 1(8):221 on A. fluviatilis; 1116 WY 24(4):37 on A. foliaceus; 1117 WY 24(4):37 on A. integrifolius; 11 WY 1(8):221 on Chrysothamnus pumilus; 109 WY 3(3):90 on Cynoglossum officinale; 406 CO 15(1):2 on Erigeron subtrinervis; 205 WY 7(3):29 on Grindelia perennis; 407 CO 15(1):2 on Gutierrezia sarothrae; 110 WY 3(3):90 on Lactuca scariola; 604 WY 21(4):143 on Mentha arvensis; 1118 WY 24(4):37 on Mertensia sp.; 105 WY 3(3):89 on M. ciliata; 111 WY 3(3):90 on Plantago major; 304 WY 10(4):33 on Solidago sp.; 106 WY 3(3):89 on Valeriana furfurescens.

ERYSIPHE GALEOPSIDIS 13 WY 1(8):221 on Stachys palustris.

ERYSIPHE GRAMINIS 1319 WY 36(4):54 on Agropyron dasystachyum; 605 CO 21(4):143 on A. repens; 606 CO 21(4):143 on A. riparium; 1119 WY 24(4):37 on A. trachycaulum; 607 WY 21(4):143 on Bromus marginatus; 1120 WY 24(4):37, 1318 WY 36(4):54 on Poa ampla; 206 WY 7(3):29 on P. canbyi; 1121 WY 24(4):37 on P. pratensis.

ERYSIPHE HORRIDULA 1320 AZ 36(4):54 on Amsinckia intermedia; 1525 AZ M8(2):388 on Cryptantha barbigera; 1526 AZ M8(2):388 on Lappula redowskii.

ERYSIPHE POLYGONI 15 WY 1(8):221 on Aquilegia caerulea; 14 WY 1(8):221 on Astragalus alpinus; 608 WY 21(4):143 on A. canadensis; 408 WY 15(1):2 on A. decumbens; 409 NM 15(1):2 on Clematis ligusticifolia; 1122 WY 24(4):37 on Lupinus argenteus; 112 WY 3(3):90 on Polygonum aviculare; 305 WY 10(4):33 on P. buxaforme; 207 WY 7(3):30 on P. exsertum; 113 WY 3(3):90 on Thermopsis divaricarpa; 1123 WY 24(4):38 on Trifolium longipes.

EXIDIA GLANDULOSA 679 CO 21(4):151 on Quercus gambelii.

EXIDIA SACCHARINA 1152 WY 24(4):42 on wood.

EXOBASIDIUM UVAE-URSI 1354 WY 36(4):58 on Arctostaphylos uva-ursi.

EXOBASIDIUM VACCINII 452 CO 15(1):11 on Arctostaphylos uva-ursi; 287 WY 7(3):38 on Menziesia ferruginea; 1355 WY 36(4):58, 451 WY 15(1):11 on Vaccinium scoparium.

EXOBASIDIUM VACCINII-ULIGINOSI 1153 WY 24(4):42 on Vaccinium membranaceum; 1154 WY 24(4):42 on V. scoparium.

FABRAEA MACULATA 404 CO 15(1):1 on Amelanchier oreophila.

FOMES IGNIARIUS 1552 WY M8(2):390 on Populus tremuloides.

FOMES NIGROLIMITATUS 360 CO 10(4):39 on Picea engelmannii.

FOMES PINI 361 CO 10(4):39, 362 WY 10(4):39 on Picea engelmannii; 363 WY 10(4):39 on wood.

FOMES PINICOLA 364 CO 10(4):40 on Picea engelmannii.

FUSICLADIUM DEPRESSUM 199 WY 3(3):99 on Angelica ampla.

GANODERMA APPLANATUM 365 CO 10(4):40 on Populus tremuloides.

GASTEROCYBE LATERITIA 1556 WY M8(2):390 on ground.

GEOPYXIS CUPULARIS 1540 WY M8(2):389 on ground.

GLOEOSPORIUM BETULICOLA 1377 UT 36(4):63 on Betula occidentalis.

GLOEOSPORIUM BOREALE 487 AZ 15(1):23 on Salix sp.; 191 WY 3(3):98 on S. glaucops; 190 WY 3(3):98 on S. monticola.

GLOEOSPORIUM RIBIS 1569 WY M8(2):391 on Ribes inerme; 483 WY 15(1):20 on R. saxosum.

GUEPINIOPSIS ALPINUS 680 WY 21(4):152, 1549 WY M8(2):389 on wood.

GYMNOSPORANGIUM BETHELII 716 MT 12(5):158, 1024 WY 24(3):25 on Crataegus douglasii; 637 UT 21(4):147 on C. rivularis; 638 CO 21(4):147 on C. succulenta.

GYMNOSPORANGIUM CLAVARIAEFORME 717 CO 21(5):158, 1025 WY 24(3):25, 1218 WY 36(3):40 on Amelanchier alnifolia; 228 WY 7(3):32 on Juniperus communis.

GYMNOSPORANGIUM CORNUTUM 1219 WY 36(3):40 on Sorbus scopulina.

GYMNOSPORANGIUM INCONSPICUUM 170 CO 3(3):95 on Amelanchier alnifolia; 929 AZ 23(4):42 on A. bakeri; 928 UT 23(4):42 on A. utahensis; 1220 UT 36(3):40 on Juniperus osteosperma.

GYMNOSPORANGIUM JUVENESCENS 639 UT 21(4):147 on Amelanchier alnifolia.

GYMNOSPORANGIUM KERNIANUM 1621 AZ M8(2):396 on Juniperus deppeana; 1425 AZ 36(5):72 on J. monosperma.

GYMNOSPORANGIUM NELSONII 40 WY 1(8):224, 171 WY 3(3):95, 718 MT 21(5):158, 720 CO 21(5):158 on Amelanchier alnifolia; 41 CO 1(8):224, 930 AZ 23(4):42 on A. bakeri; 1221 WY 36(3):40 on A. pumila 931 AZ

23(4):42 on A. oreophila; 932 AZ 23(4):42 on A. utahensis; 933 AZ 23(4):42, 934 NM 23(4):42 on Juniperus monosperma; 39 WY 1(8):224, 719 MT 21(5):158, 1222 UT 36(3):40 on J. scopulorum.

GYMNOSPORANGIUM NIDUS-AVIS 1622 CO M8(2):396 on Amelanchier alnifolia; 1223 WY 36(3):40 on Juniperus scopulorum.

GYMNOSPORANGIUM SPECIOSUM 935 AZ 23(4):42 on Fendlera rupicola; 936 AZ 23(4):43 on Juniperus deppeana; 1426 AZ 36(5):72 on J. monosperma;

GYMNOSPORANGIUM TREMELLOIDES 1026 WY 24(3):25 on Juniperus communis; 229 AZ 7(3):32 on Philadelphus rugosus; 640 CO 21(4):147 on Sorbus scopulina; 1224 WY 36(3):40 on S. sitchensis.

HADROTRICHUM GLOBIFERUM 1585 UT M8(2):392 on Lupinus argenteus; 1586 WY M8(2):392 on L. parviflorus; 700 WY 21(4):155 on L. sericeus.

HADROTRICHUM LUPINI 498 CO 15(1):26 on Lupinus sp.; 81 WY 1(8):228 on L. alpestris; 198 WY 3(3):99 on L. argenteus.

HELVELA INFULA 302 10(4):33 on ground.

HEMIPHACIDIUM PLANUM 1335 CO 36(4):56 on Pinus ponderosa.

HENDERSONIA CALAMOVILFAE 1156 WY 24(4):42 on Calamagrostis canadensis.

HERPOBASIDIUM DEFORMANS 1356 WY 36(4):59 on Lonicera involucrata.

HERPOTRICHIA NIGRA 620 CO 21(4):145, 26 WY 1(8):222 on Abies lasiocarpa; 124 WY 3(3):91 on Picea engelmannii.

HETEROSPORIUM AVENAE 98 WY 1(8):231 on Triticum aestivum.

HETEROSPORIUM ECHINULATUM 1195 WY 24(4):53 on Cerastium arvense.

HETEROSPORIUM GRACILE 395 WY 10(4):45 on Iris sp.

HYALOPSORA POLYPODII 315 WY 10(4):35, 915 AZ 28(4):40 on Cystopteris fragilis.

HYDNUM IMBRICATUM 359 CO 10(4):39 on ground.

HYGROPHORUS CALOPHYLLUS 383 CO 10(4):41 on ground.

HYPODERMA SACCATUM 617 CO 21(4):145 on Pinus flexilis.

HYPOXYLON PRUINATUM 1137 WY 24(4):40 on Populus tremuloides.

KABATIA FRAGARIAE 482 WY 15(1):19 on Fragaria ovalis.

KABATIA LONICERAE 1368 UT 36(4):61, 1369 WY 36(4):61 on Lonicera involucrata.

KABATIA MIRABILIS 387 WY 10(4):42 on Lonicera involucrata.

KELLERMANNIA ANOMALA 1560 CO M8(2):390 on Yucca glauca.

KELLERMANNIA MAJOR 470 NV 15(1):17 on Yucca brevifolia.

KELLERMANNIA YUCCAEGENA 471 NM 15(1):17 on Yucca elata; 181 WY 3(3):97 on Y. glauca.

KUNKELIA NITENS 721 MT 21(5):159 on Rubus pubescens.

LACHNELLULA CHRYSOPHTHALMA 1541 WY M8(2):389 on Abies lasiocarpa; 1132 WY 24(4):39 on wood.

LACTARIUS DELICIOSUS 384 CO 10(4):41 on ground.

LASIOBOLUS PILOSUS 1134 WY 24(4):39 on cow dung.

LASIOBOTRYS LONICERAE 23 ID 1(8):222 on Symphoricarpos occidentalis.

LENZITES SAEPIARIA 385 CO 10(4):41 on Picea engelmannii.

LEPTOTHYRIUM PERICLYMENI 292 WY 7(3):40 on Lonicera utahensis.

LEPTOTHYRIUM PETRAKII 689 WY 21(4):153 on Elymus cinereus.

LOPHIONEMA APOCLASTOSPORA 430 WY 15(1):7 on Salix sp.

LOPHODERMELLA ARCUATA 1336 CO 36(4):56 on Pinus flexilis.

LOPHODERMELLA CERINA 1337 AZ 36(4):56, 1338 CO 36(4):56, 1338 CO 36(4):56 on Pinus ponderosa.

LOPHODERMELLA MONTIVAGA 1339 CO 36(4):57, 1340 WY 36(4):57 on Pinus contorta.

LOPHODERMIUM DECORUM 1341 CO 36(4):57 on Abies concolor.

MARSSONIA GALII 92 AZ 1(8):230 on Galium asperrimum.

MARSSONIA KRIEGERIANA 293 WY 7(3):40 on Salix exigua.

MARSSONIA POTENTILLAE 294 NM 7(3):41 on Fragaria sp.

MARSSONINA BRUNNEA 484 WY 15(1):20, 1570 AZ M8(2):391 on Populus tremuloides.

MARSSONINA CHRYSOTHAMNI 1378 WY 36(4):63 on Chrysothamnus parryi.

MARSSONINA KRIEGERIANA 487 AZ 15(1):23 on Salix sp; 1165 WY 24(4):45 on S. drummondiana; 293 WY 7(3):40 on S. exigua; 191 WY 3(3):98 on S. glaucops; 190 WY 3(3):98 on S. monticola; 692 WY 21(4):154 on S. subcoerulea.

MARSSONINA POPULI 485 WY 15(1):23 on Populus sp; 486 WY 15(1):23 on P. angustifolia.

MARSSONINA POTENTILLAE 1571 WY M8(2):391 on Potentilla fissa.

MELAMPSORA ABIETI-CAPRAEARUM 1202 WY 36(3):38 on Abies lasiocarpa; 1203 WY 36(3):38 on Salix sp; 916 AZ 23(4):40 on S. bebbiana; 503 CO 18(2):71 on S. exigua; 138 WY 3(3):92 on S. subcoerulea.

MELAMPSORA ALBERTENSIS 141 WY 3(3):93 on Populus sp.; 140 WY 3(3):92, 629 CO 21(4):146 on P. angustifolia; 34 WY 1(8):223, 139 CO 3(30):92 on P. tremuloides.

MELAMPSORA AMERICANA 142 WY 3(3):93 on Salix amygdaloides; 35 WY 1(8):223 on S. bebbiana.

MELAMPSORA ARCTICA 1204 WY 36(3):38 on Salix anglorum.

MELAMPSORA BIGELOWII 316 WY 10(4):35 on Salix bebbiana; 37 WY 1(8):223 on S. exigua; 36 WY 1(8):223 on S. fluviatilis; 143 WY 3(3):93 on S. nelsonii; 144 WY 3(3):93 on S. scouleriana.

MELAMPSORA CONFLUENS 145 WY 3(3):93 on Salix sp.

MELAMPSORA EPITEA 1404 UT 36(5):69 on Ribes inerme; 1408 WY 36(5):70, 1409 WY 36(5):70, 1606 WY M8(2):396 on Salix sp.; 1406 WY 36(5):70 on S. amygdaloides; 1407 AZ 36(5):70 on S. bonplandiana; 1405 UT 36(5):70 on S. drummondiana; 1608 WY M8(2):396 on S. geyeriana; 1607 AZ M8(2):396 on S. scouleriana.

MELAMPSORA LINI 216 WY 7(3):31, 917 AZ 23(4):40, 1410 UT 36(5):70, 1411 AZ 36(5):70, 1412 AZ 36(5):70, 1609 UT M8(2):396 on Linum lewisii.

MELAMPSORA MEDUSAE 1206 WY 36(3):38, 1207 WY 36(3):38, 1610 AZ M8(2):396 on Populus tremuloides; 1205 WY 36(3):38 on Pseudotsuga menziesii.

MELAMPSORA MONTICOLA 918 AZ 23(4):41 on Euphorbia incisa; 919 CO 23(4):41 on E. robusta.

MELAMPSORA OCCIDENTALIS 504 MT 18(2):70 on Populus angustifolia; 706 MT 21(5):157 on Pseudotsuga taxifolia.

MELAMPSORA PARADOXA 1008 WY 24(3):23, 1413 CN 36(5):70, 630 WY 21(4):146 on Salix amygdaloides; 1611 WY M8(2):396 on S. bebbiana; 1006 WY 24(3):23, 1007 WY 24(3):23 on S. geyeriana; 1613 WY M8(2):396 on S. lutea; 1414 WY 36(5):71, 1612 WY M8(2):396 on S. myrtillifolia; 1009 WY 24(3):23 on S. pseudocordata.

MELAMPSORA RIBESII-PURPUREAE 1010 WY 24(3):23 on Ribes inerme; 1011 WY 24(3):23 on R. lacustre; 217 WY 7(3):31, 505 CO 18(2):72, 506 NM 18(2):72, 507 ID 18(2):72, 1014 WY 24(3):24, 1209 WY 36(3):38, 1415 UT 36(5):71 on Salix sp.; 1208 WY 36(3):38 on S. amygdaloides; 317 WY 10(4):35 on S. bebbiana; 508 WY 18(2):72 on S. drummondiana; 1013 WY 24(3):24 on S. geyeriana; 920 AZ 23(4):41 on S. laevigata; 509 ID 18(2):72 on S. ligulifolia; 631 UT 21(4):146 on S. lutea; 218 WY 7(3):31 on S. nuttallii; 1015 WY 24(3):24, 510 WY 18(2):72 on S. pseudocordata; 1012 WY 24(3):23 on S. scouleriana; 921 CO 23(4):41 on S. subcoerulea.

MELAMPSORELLA CARYOPHYLLACEARUM 632 UT 21(4):146, 707 CO 21(5):157, 1210 UT 36(3):39, 1416 ID 36(5):71 on Abies lasiocarpa; 633 UT 21(4):146, 922 AZ 23(4):41 on Picea engelmannii; 1016 WY 24(3):24, 1017 WY 24(3):24 on Picea pungens.

MELAMPSORELLA CERASTII 219 WY 7(3):31, 220 WY 7(3):31 on Abies lasiocarpa; 222 WY 7(3):31 on Cerastium arvense; 221 WY 7(3):31 on Picea engelmannii.

MELASMIA IMITANS 90 WY 1(8):230 on Pteridium aquilinum.

MICROSPHAERA ALNI 609 WY 21(4):143 on Lonicera utahensis; 410 CO 15(1): 2, 411 NM 15(1):3 on Quercus gambelii; 117 WY 3(3):90 on Vaccinium oreophilum; 16 WY 1(8):221 on Vicia trifida.

MICROSPHAERA DIFFUSA 118 WY 3(3):90 on Symphoricarpos occidentalis.

MICROSPHAERA LONICERAE 1321 WY 36(4):54 on Lonicera involucrata.

MYCOSPHAERELLA FRAGARIAE 1138 ID 24(4):40 on Fragaria ovalis.

MYCOSPHAERELLA FRAXINICOLA 431 NM 15(1):8 on Fraxinus macropetala; 432 ID 15(1):8 on F. velutina.

NECTRIA CINNABARINA 1527 AZ M8(2):388 on Acer glabrum; 426 CO 15(1):5 on A. negundo.

NEOPECKIA COULTERI 309 WY 10(4):34 on Picea engelmannii; 125 WY 3(3): 91 on Pinus contorta.

NYSSOPSORA CLAVELLOSA 1623 AZ M8(2):397 on Aralia racemosa.

NYSSOPSORA ECHINATA 1624 WY M8(2):397 on Ligusticum porteri.

OIDIUM AMBROSIAE 1587 AZ M8(2):393 on Ambrosia confertifolia.

OPHIOBOLUS FESTUCAE 1528 WY M8(2):388 on Festuca idahoensis.

OVULARIA ASTERIS 297 WY 7(3):41, 1169 WY 24(4):46 on Aster engelmannii.

OVULARIA BISTORTAE 1381 WY 36(4):65 on Polygonum bistortoides.

OVULARIA BULBIGERA 693 ID 21(4):154 on Sanguisorba sitchensis.

OVULARIA COMPACTA 1170 WY 24(4):46, 1382 WY 36(4):65 on Agoseris glauca.

OVULARIA DECIPIENS 393 WY 10(4):44 on Ranunculus macounii.

OVULARIA DELPHINII 394 WY 10(4):44 on Delphinium barbeyi; 1171 WY 24(4):46 on D. bicolor; 1383 WY 36(4):65 on D. burkei.

OVULARIA MONOSPORIA 1588 M8(2):399 on Rumex crispus; 1589 AZ M8(2):399 on R. hymenosepalus.

OVULARIA OBLIQUA 93 CO 1(8):231 on Rumex crispus.

PASSALORA DEPRESSA 1196 WY 24(4):54 on Angelica pinnata; 1400 WY 36(4):67 on Perideridia gairdneri.

PASSALORA GRAMINIS 1197 WY 24(4):54 on Bromus anomalus; 1198 WY 24(4): 54 on B. marginatus; 1199 WY 24(4):54 on Hordeum brachyantherum.

PERIDERMIUM FILAMENTOSUM 923 NM 23(4):41, 924 AZ 23(4):41 on Pinus ponderosa.

PERIDERMIUM HOLWAYI 1300 WY 36(3):49 on Abies lasiocarpa.

PERONOSPORA ARBORESCENS 1503 WY M8(2):386 on Argemone polyanthemos.

PERONOSPORA ARTHURI 1308 AZ 36(4):52 on Epilobium minutum; 1504 AZ M8(2):386 on Camissonia chamaenerioides; 1309 AZ 36(4):52, 1573 AZ M8(2):393 on Oenothera primiveris.

PERONOSPORA CORYDALIS 1505 AZ M8(2):386 on Corydalis aurea.

PERONOSPORA ECHINOSPERMI 1310 AZ 36(4):52 on Amsinckia intermedia; 1506 AZ M8(2):386 on Lappula redowskii.

PERONOSPORA EFFUSA 5WY 1(8):220 on Chenopodium album.

PERONOSPORA FARINOSA 1311 AZ 36(4):53, 1312 WY 36(4):53 on Chenopodium album.

PERONOSPORA FICARIAE 1507 WY M8(2):386 on Ranunculus acriformis.

PERONOSPORA FLOERKEAE 1109 WY 24(4):35 on Floerkea prosperinacoides.

PERONOSPORA LEPIDII 1508 AZ M8(2):386 on Lepidium medium; 1509 AZ M8(2):386 on L. thurberi.

PERONOSPORA PARASITICA 1517 AZ M8(2):387 on Arabis drummondii; 1110 ID 24(4):36 on A. holboellii; 1313 AZ 36(4):53, 1511 AZ M8(2):386, 1512 AZ M8(2):386 on Descurainia pinnata; 1513 WY M8(2):387 on D. richardsonii; 1514 AZ M8(2):387 on Draba cuneifolia; 202 WY 7(3):29 on D. nemorosa; 1515, 1516 AZ M8(2):387 on Lepidium lasiocarpum; 1517 AZ M8(2):387 on L. medium; 1314 AZ 36(4):53 on Lesquerella gordonii; 1518 AZ M8(2):387, 1519 AZ M8(2):387 on L. purpurea; 6 WY 1(8):220 on Sophia procera; 1315 AZ 36(4):53 on Streptanthus arizonicus; 1316 AZ 36(4):53 on Thelypodium lasiophyllum.

PERONOSPORA POTENTILLAE 1111 WY 24)4):36 on Potentilla gracilis; 203 WY 7(3):29 on P. nuttallii; 1112 WY 24(4):36 on P. pulcherrima.

PERONOSPORA TABACINA 1317 AZ 36(4):54 on Nicotiana trigonophylla.

PERONOSPORA TRIFOLIORUM 1520 WY M8(2):387 on Astragalus alpinus; 7 WY 1(8):220 on Medicago sativa.

PHLEOSPORA ACERIS 682 UT, 683 WY, 684 CO 21(4):152 on Acer negundo.

PHLEOSPORA BALSAMORHIZAE 1157 WY 24(4):43 on Balsamorhiza sagittata.

PHLEOSPORA CARAGANAE 685 WY 21(4):152 on Caragana arborescens.

PHLEOSPORA DEARNESSII 477 NM 15(1):18 on Alnus oblongifolia.

PHLEOSPORA LUNELLIANA 1359 WY 36(4):59 on Carex platylepis.

PHLEOSPORA MUHLENBERGIAE 478 AZ 15(1):18 on Muhlenbergia arizonica.

PHLEOSPORA OSMORRHIZAE 291 WY 7(3):40 on Osmorhiza divaricata; 479 WY 15(1):19, 480 CO 15(1);19, 1158 WY 24(4):43 on O. obtusa; 1159 WY 24(4):43 on O. occidentalis; 481 WY 15(1):19 on Pseudocymopteris montanus.

PHLEOSPORA PSEUDOPLATANI 460 CO 15(1):14 on Acer negundo.

PHRAGMIDIUM ANDERSONII 230 WY 7(3):32, 722 CO 21(5):159, 1225 WY 36(3):40 on Potentilla fruticosa.

PHRAGMIDIUM FUSIFORME 516 CO 18(2):73 on Rosa sp; 723 MT 21(5):159, 1625 MT M8(2):397, 1626 WY M8(2):397 on R. acicularis; 517 MT 18(2):73 on R. engelmannii; 1427 MT 36(5):72, 1428 WY 36(5):72 on R. woodsii.

PHRAGMIDIUM IVESIAE 724 WY 21(5):159 on Potentilla concinna; 1226 WY 36(3):40 on P. diversifolia; 518 WY 18(2):73 on P. flabelliformis; 231 WY 7(3):32, 725 MT 21(5):159, 1028 WY 24(3):25, 1627 WY M8(2):397 on P. gracilis; 232 WY 7(3):32 on P. nuttallii; 726 CO 21(5):159, 1027 WY 24(3):25 on P. pulcherrima.

PHRAGMIDIUM MONTIVAGUM 42 WY 1(8):224 on Rosa sp.; 728 CO 21(5):159, 1029 WY 24(3):25, 1629 WY M8(2):397 on R. acicularis; 519 CO 18(2):73, 938 AZ 23(4):43 on R. fendleri; 937 AZ 23(4):43 on R. manca; 520 ID 18(2):73, 521 WY 18(2):73, 1030 WY 24(3):25, 1429 UT 36(5):72, 1430 WY 36(5):72, 1628 MT M8(2):397 on R. woodsii.

PHRAGMIDIUM OCCIDENTALE 146 WY 3(3):93, 522 MT 18(2):73, 1031,WY 24(3):25, 1431 MT 36(5):72 on Rubus parviflorus.

PHRAGMIDIUM PECKIANUM 318 CO 19(4):35, 1032 WY 24(3):26 on Rubus deliciosus; 939 AZ 23(4):43, 940 AZ 23(4):43 on R. neomexicanus.

PHRAGMIDIUM POTENTILLAE 641 WY 21(4):147, 727 CO 21(5):159 on Potentilla pennsylvanica , 253 WY 7(3):33 on P. strigosa.

PHRAGMIDIUM ROSAE-ACICULARIS 147 WY 3(3):93, 319 CO 10(4):35 on Rosa acicularis.

PHRAGMIDIUM ROSAE-ARKANSANAE 148 WY 3(3):93 on Rosa sp.

PHRAGMIDIUM ROSAE-PIMPINELLIFOLIAE 1432 WY 36(5):73 on Rosa foetida.

PHRAGMIDIUM RUBI-IDAEI 523 CO 18(2):73 on Rubus sp; 1227 WY 36(3):40, 1433 MT 36(5):73, 1630 WY M8(2):388 on R. idaeus; 729, 730 MT 21(5):159 on R. leucodermus; 941 AZ 23(4):43, 1033 WY 24(3):26 on R. strigosus.

PHRAGMODOTHIS CONSPICUA 83 CO 1(8):228 on Yucca glauca.

PHRAGMOPYXIS ACUMINATA 1434 AZ 36(5):73 on Coursetia microphylla.

PHRAGMOPYXIS DEGLUBENS 1435 AZ 36(5):73 on Cracca edwardsii.

PHYLLACHORA EPICAMPIS 433 AZ 15(1):8 on Muhlenbergia emerslyi; 434 AZ 15(1):8 on M. longiligula; 1529 NM M8(2):388 on M. metcalfii; 1530 AZ M8(2):388 on M. ringens.

PHYLLACHORA GRAMINIS 211 WY 7(3):30 on Bromus anomalus.

PHYLLACHORA HERACLEI 25 WY 1(8):222 on Heracleum lanatum.

PHYLLACHORA VULGATA 435 AZ 15(1):9 on Muhlenbergia glauca.

PHYLLACHORA WITTROCKII 1330 WY 36(4):56 on Linnaea borealis.

PHYLLACTINIA CORYLEA 412 CO 15(1):3, 613 WY 21(4):144 on Acer negundo; 308 WY 10(4):34, 413 NM 15(1):3 on Alnus tenuifolia; 417 CO 15(1):4 on Amelanchier oreophila; 414 NM 15(1):3 on Fraxinus macropetala; 415 UT 15(1):3 on F. velutina; 418 NM 15(1):4 on Populus angustifolia; 416 AZ 15(1):3 on Robinia neomexicana; 419 NM 15(1):4 on Rudbeckia laciniata.

PHYLLOSTICTA SP. 1199 WY 24(4):54 on Bromus marginatus.

PHYLLOSTICTA ALPINICOLA WY 454 15(1):11 on Trifolium parryi.

PHYLLOSTICTA ANGELICAE 173 WY 3(3):95 on Angelica ampla.

PHYLLOSTICTA ARNICAE 174 WY 3(3):96, 1360 WY 36(4):59, 1361 WY 36(4):6 on Arnica cordifolia.

PHYLLOSTICTA BRUNNEA 455 CO 15(1):12, 456 NM 15(1):12 on Populus angustifolia; 1561 AZ M8(2):390 on P. fremontii.

PHYLLOSTICTA CARPINI 457 NM 15(1):12, 477 NM 15(1):18 on Alnus oblongifolia.

PHYLLOSTICTA CINEREA 458 AZ 15(1):14 on Rhamnus betulaefolia.

PHYLLOSTICTA DECIDUA 1179 WY 24(4):48,1362 WY 36(4):6 on Mentha arvensis.

PHYLLOSTICTA DELPHINII 1383 WY 36(4):65 on Delphinium burkei.

PHYLLOSTICTA FERAX 498 CO 15(1):26 on Lupinus sp.; 81 WY 1(8):228 on L. alpestris; 198 WY 3(3):99, 1363 WY 36(4):6, 1585 UT M8(2):392 on L. argenteus; 700 WY 21(4):155 on L. sericeus.

PHYLLOSTICTA GARRETTII 175 WY 3(3):96 on Senecio triangularis.

PHYLLOSTICTA MELANOCARPA 1376 UT 36(4):63 on Veratrum californicum.

PHYLLOSTICTA MINUTISSIMA 176 WY 3(3):96, 459 CO 15(1):14, 1371 MT 36 (4):62 on Acer glabrum; 690 UT 21(4):153 on A. grandidentata.

PHYLLOSTICTA PEDICULARIDIS 1160 WY 24(4):44 on Pedicularis paysoniana.

PHYLLOSTICTA PLATANOIDIS 460 CO 15(1):14, 461 NM 15(1):14 on Acer negundo.

PHYLLOSTICTA RAGNHILDAE 462 WY 15(1):14 on Antennaria pulcherrima.

PHYLLOSTICTA ROSICOLA 463 CO 15(1):15 on Rosa sp.

PHYLLOSTICTA SAXIFRAGARUM 177 WY 3(3):96 on Saxifraga arguta.

PHYLLOSTICTA SMILACINAE 464 CO 15(1):15 on Smilacina amplexicaulis.

PHYLLOSTICTA SOLIDAGINIS 178 WY 3(3):96 on Solidago canadensis; 465 CO 15(1):15 on S. petradoria.

PHYLLOSTICTA TETONENSIS 1364 WY 36(4):60 on Clematis hirsutissima.

PHYLLOSTICTA TROLLII 179 WY 3(3):96, 295 WY 7(3):41 on Trollius albiflorus.

PHYLLOSTICTA VIRGINIANA 467 NM 15(1):16 on Prunus sp.; 466 AZ 15(1):16 on P. virens.

PHYLLOSTICTA WYOMINGENSIS 180 WY 3(3):96 on Epilobium angustifolium.

PHYSALOSPORA ASTRAGALI 29 WY 1(8):223 on Astragalus bisulcatus.

PHYSODERMA MENYANTHIS 201 WY 7(3):29, 1301 CO 36(4):51 on Menyanthes trifoliata.

PHYSODERMA PLURIANNULATUM 1103 WY 24(4):35 on Angelica pinnata.

PILEOLARIA BREVIPES 1436 AZ 36(5):73 on Rhus radicans.

PILEOLARIA PATZCUARENSIS 524 NM 18(2):74 on Rhus trilobata.

PLASMOPARA GERANII 1113 WY 24(4):36, 1521 WY M8(2):387 on Geranium richardsonii.
PLASMOPARA HALSTEDII 4 WY 1(8):220 on Franseria discolor; 3 WY 1(8):220 on Helianthus annuus; 402 WY 15(1):1 on H. nuttallii.
PLASMOPARA PYGMAEA 1114 WY 24(4):36 on Aconitum columbianum.
PODOSPHAERA OXYACANTHAE 17 WY 1(8):221 on Prunus melanocarpa; 119 WY 3(3):90 on Spiraea lucida.
POLYPORUS ABIETINUS 366 CO 10(4):40 on wood.
POLYPORUS ADUSTUS 1553 WY M8(2):390 on Populus tremuloides.
POLYPORUS ALBOLUTEUS 367 CO 10(4):40 on Picea engelmannii.
POLYPORUS CIRCINATUS 368 CO 10(4):40, 681 CO 21(4):152 on ground.
POLYPORUS DICHROUS 1554 WY M8(2):390 on Pinus contorta.
POLYPORUS LEUCOSPONGIA 370 CO 10(4):40 on Picea engelmannii.
POLYPORUS OVINUS 369 CO 10(4):40 on ground.
POLYPORUS TOMENTOSUS 681 CO 21(4):52 on ground.
POLYSTIGMA ASTRAGALI 1136 WY 24(4):40 on Astragalus agrestis.
POLYTHRINCIUM TRIFOLII 97 WY 1(8):231 on Trifolium hybridum.
PSEUDOPEZIZA MEDICAGINIS 8 CO 1(8):220,1542 AZ M8(2):389 on Medicago sativa.
PSEUDOPEZIZA REPANDA 616 WY 21(4):144, 1328 WY 36(4):55 on Galium boreale.
PSEUDOPEZIZA RIBIS 405 WY 15(1):2 on Ribes cereum; 1133 WY 24(4):39 on R. inerme.
PSEUDOPLECTANIA NIGRELLA 1543 WY M8(2):389 on ground.
PUCCINIA ABERRANS 642 WY 21(4):147 on Smelowskia calycina.
PUCCINIA ABRUPTA 942 AZ 23(4):43, 1631 AZ M8(2):397 on Viguiera dentata.
PUCCINIA ABSINTHII 235 WY 7(3):33 on Artemisia aromatica; 234 WY 7(3):33 on A. cana; 525 AZ 18(2):74, 526 UT 18(2):74 on A. dracunculoides; 527 NM 18(2):74 on A. ludoviciana; 149 CO 3(3):93, 528 NM 18(2):74 on A. tridentata; 529 WY 10(2):74 on A. tripartita.
PUCCINIA ACROPHILA 1632 WY M8(2):397 on Syntheris pinnatifida.
PUCCINIA ADOXAE 1437 CO 36(5):73 on Adoxa moschatellina.
PUCCINIA AEMULANS 530 CO 18(2):74, 531 WY 18(2):74; 943 AZ 23(4):43, 944 AZ 23(4):43, 1034 WY 24(3):26 on Viguiera multiflora.
PUCCINIA ALLENII 43 WY 1(8):224 on Shepherdia canadensis.
PUCCINIA AMPHIGENA 643 WY 21(4):147 on Calamovilfa longifolia.
PUCCINIA ANDROPOGONIS 801 CO 23(3):23, 803 NM 23(3):24 on Andropogon hallii; 805 NM 23(3):24 on A. scoparius; 804 NM 23(3):24 on Penstemon alpinus; 802 NM 23(3):23 on Petalostemon purpureus.
PUCCINIA ANGUSTATA 1633 WY M8(2):397 on Mentha arvensis.
PUCCINIA ANISACANTHI 532 AZ 18(2):74 on Anisacanthus thurberi.
PUCCINIA APOCRYPTA 46 WY 1(8):224 on Hydrophyllum fendleri.
PUCCINIA ARISTIDAE 533 WY 18(2):74 on Distichlis spicata; 806 MT 23(3):24 on D. stricta; 236 WY 7(3):33 on Sarcobatus vermiculatus; 237 WY 7(3):33 on Triglochin maritima.
PUCCINIA ARNICALIS 1228 WY 36(3):41 on Arnica chamissonis; 320 WY 10(4):35, 731 CO 21(5):160 on A. cordifolia; 732 CO 21(5):160, 1438 WY 36(5):73 on A. mollis.
PUCCINIA ASTERIS 1229 WY 36(3):41 on Aster conspicuus; 733 MT 21(5):160 on A. falcatus; 44 WY 1(8):224 on A. glaucus; 1230 WY 36(3):41 on Erigeron elatior.
PUCCINIA ATRA 534 NM 18(2):75, 535 AZ 18(2):75 on Panicum bulbosum; 536 AZ 18(2):75 on Setaria grisebachii.
PUCCINIA ATROFUSCA 734 MT 21(5):160 on Artemisia dracunculoides; 537 MT 18(2):75, 945 AZ 23(4):44 on Carex douglasii; 736 MT 21(5):160 on

C. eleocharis; 735 WY 21(5):160, 1439 WY 36(5):73 on C. filifolia; 538 WY 18(2):75 on C. geyeri; 1231 WY 36(3):41 on C. hoodii; 946 CO 23(4):44 on C. rossii.

PUCCINIA BACCHARIDIS 1440 AZ 36(5):73 on Baccharis glutinosa.

PUCCINIA BALSAMORHIZAE 47 ID 1(8):225, 238 WY 7(3):33, 737 MT 21(5): 160 on Balsamorhiza sagittata; 738 CO 21(5):160 on Wyethia arizonica.

PUCCINIA BIPORULA 947 AZ 23(4):44, 948 AZ 23(4):44 on Salvia lemmonii.

PUCCINIA BISTORTAE 539 MT 18(2):75 on Bistorta bistortoides; 48 WY 1(8):225, 739 CO 21(5):160, 740 CO 21(5):160, 1035 WY 24(3):26 on Polygonum bistortoides; 239 WY 7(3):33 on P. viviparum.

PUCCINIA BLASDALEI 741 CO 21(5):161 on Allium cernuum; 1441 AZ 36(5): 73 on A. macropetalum.

PUCCINIA BRACHYPODII 1232 WY 36(3):41 on Deschampsia caespitosa; 1233 WY 36(3):41 on Phleum pratense; 1234 WY 36(3):41 on Poa alpina; 1235 WY 36(3):42, 1442 WY 36(5):74, 1634 CO M8(2):397 on P. interior; 1443 WY 36(5):74 on P. leptocoma; 1236 WY 36(3):42 on P. reflexa.

PUCCINIA CACABATA 1445 AZ 36(5):74 on Bouteloua aristidoides; 1446 AZ 36(5):74 on B. barbata; 1447 AZ 36(5):74 on B. rothrockii; 1444 AZ 36(5):74 on Gossypium hirsutum.

PUCCINIA CALANTICARIAE 1448 AZ 36(5):74 on Viguiera dentata.

PUCCINIA CALCITRAPAE 1237 WY 36(3):42 on Arctium minus; 1449 WY 36(5):74 on Cirsium centaureae; 1450 WY 36(5):74 on C. undulatum.

PUCCINIA CALOCHORTI 742 MT 21(5):161 on Calochortus apiculatus; 1635 WY M8(2):397 on C. gunnisonii.

PUCCINIA CANALICULATA 950 AZ 23(4):44 on Cyperus rusbyi; 949 AZ 23(4):44 on Heliopsis parvifolia.

PUCCINIA CARICINA 1239 UT 36(3):42 on Carex sp; 1637 WY M8(2):397 on C. aquatilis; 743 MT 21(5):161 on C. hepburnii; 1451 WY 36(5):75, 1638 WY M8(2):397 on C. nebraskensis; 644 WY 21(4):148, 952 CO 23 (4):45, 1038 ID 24(3):26, 1238 WY 36(3):42 on C. rostrata; 953 AZ 23(4):45 on C. senta; 1036 WY 24(3):26 on Ribes inerme; 1636 WY M8 (2):397 on R. setosum; 951 CO 23(4):44 on Urtica dioica; 1037 WY 24(3):26 on U. gracilis.

PUCCINIA CARICIS 540 WY 18(2):75 on Carex aquatilis; 150 WY 3(3):93 on C. rostrata; 321 WY 10(4):35 on Urtica gracilis.

PUCCINIA CARTHAMI 1452 AZ 36(5):75 on Carthamus tinctorius.

PUCCINIA CICUTAE 954 AZ 23(4):45 on Cicuta douglasii; 49 WY 1(8):225 on C. occidentalis.

PUCCINIA CIRSII 322 WY 10(4):35 on Cirsium americanum; 955 23(4):45 on C. arizonicum; 1240 WY 36(3):42 on C. canescens; 744 MT 21(5): 161 on C. edule; 151 WY 3(3):93 on C. engelmannii; 645 WY 21(4):148 on C. foliosum; 956 AZ 23(4):45 on C. nidulum; 745 MT 21(5):161 on C. undulatum.

PUCCINIA CLAYTONIICOLA 541 WY 18(2):75 on Claytonia lanceolata.

PUCCINIA CLEMATIDIS 50 WY 1(8):225 on Thalictrum occidentale.

PUCCINIA CLINTONII 1241 BC 36(3):42 on Pedicularis bracteosa; 746 CO 21(5):161 on P. groenlandica; 240 WY 7(3):33, 1039 WY 24(3):26 on P. paysoniana.

PUCCINIA CNICI 542 UT 18(2):76 on Cirsium scariosum.

PUCCINIA CONFERTA 152 WY 3(3):94 on Artemisia ludoviciana.

PUCCINIA CONOCLINII 1639 AZ M8(2):398 on Eupatorium pycnocephalum.

PUCCINIA CONSIMILIS 52 WY 1(8):225 on Schoenocrambe linifolia.

PUCCINIA CONSPICUA 808 AZ 21(3):24 on Agrostis scabra; 807 AZ 21(3):24 on Helenium hoopesii.

PUCCINIA CORONATA 1245 WY 36(3):43, 647 WY 21(4):148 on Agropyron trachycaulum; 544 UT 18(2):76, 648 WY 21(4):148, 813 MT 23(3):25

on Agrostis alba; 1248 WY 36(3):43 on Bromus anomalus; 545 WY 18(2): 76 on B. ciliatus; 649 WY 21(4):148 on B. porteri; 546 MT 18(2):76 on Calamagrostis sp.; 547 WY 18(2):76, 810 MT 23(3):25, 1041 WY 24(3):27, 1042 WY 24(3):27 on C. canadensis; 548 WY 18(2):76 on C. inexpansa; 812 MT 23(3):25, 1044 WY 24(3):27, 1243 WY 36(3):42, 1247 WY 36(3):43, 1453 WY 36(5):75 on C. rubescens; 650 WY 21(4): 148 on Deschampsia caespitosa; 1242 WY 36(3):42, 1244 WY 36(3):43, 1246 WY 36(3):43 on Elaeagnus canadensis; 814 AZ 23(3):25 on Holcus lanatus; 241 WY 7(3):33 on Koeleria cristata; 549 WY 18(2):76 on Phalaris arundinacea; 809 WY 23(3):24, 1040 WY 24(3):26 on Rhamnus alnifolia; 543 MT 18(2):76, 646 WY 21(4):148, 811 MT 23(3):25, 1043 WY 24(3):27 on Shepherdia canadensis.

PUCCINIA CRANDALLII 818 MT 23(3):26 on Festuca idahoensis; 824 MT 23(3):27 on F. ovina; 820 MT 23(3):26 on F. scabrella; 816 CO 23(3):26, 1250 WY 36(3):43, 1252 WY 36(3):44, 1454 WY 36(5):75 on Hesperochloa kingii; 822 AZ 23(3):25, 957 CO 23(4):45, 1642 AZ M8 (2):398 on Poa fendleriana; 823 AZ 23(3):27 on Poa longiligula; 815 CO 23(3):25, 1640 MT M8(2):398, 1641 WY M8(2):398 on Symphoricarpos albus; 242 WY 7(3):33, 817 MT 23(3):26, 819 MT 36(3):43, 1249 WY 36(3):43, 1251 WY 36(3):44 on S. occidentalis; 821 AZ 23(3):26 on S. oreophilus; 243 WY 7(3):34 on S. racemosus; 651 WY 21(4):148, 1045 WY 24(3):27 on S. vaccinioides.

PUCCINIA CREPIDIS-MONTANAE 550 WY 18(2):77 on Crepis glauca; 747 MT 21(5):161 on C. runcinata.

PUCCINIA CRUCIFERARUM 652 WY 21(4):148 on Cardamine cordifolia.

PUCCINIA DESCHAMPSIAE 825 CO 23(3):27 on Deschampsia caespitosa.

PUCCINIA DIOICAE 958 MT 23(4):45, 1046 WY 24(3):27, 1047 WY 24(3):27 1253 WY 36(3):44, 1455 WY 36(5):75 on Agoseris glauca; 960 AZ 23(4); 46 on Artemisia carruthii; 748 MT 21(5):161, 1456 WY 36(5):75, 1643 WY M8(2):398 on Aster foliaceus; 1050 ID 24(3):27 on Carex eastwoodii; 959 MT 23(4):46 on C. filifolia; 1051 WY 24(3):28 on C. hoodii; 1255 WY 36(3):44 on C. petasata; 963 AZ 23(4):46 on C. praegracilis; 961 AZ 23(4):46 on C. rusbyi; 1254 WY 36(3):44 on C. vernacula; 1457 CO 36(5):75 on Erigeron speciosus; 1048 WY 24(3):27 on Hieracium cusickii; 964 CO 23(4):46 on Oenothera caespitosa; 749 MT 21(5):161, 962 AZ 23(4):46 on Solidago missouriensis; 965 CO 23(4):46, 1458 WY 36(5):75 on Valeriana edulis; 1049 WY 24(3):27 on V. occidentalis.

PUCCINIA DISTORTA 1644 AZ M8(2):398 on Hyptis emoryi.

PUCCINIA DOUGLASII 244 WY 7(3):34 on Phlox glabrata.

PUCCINIA DRABAE 1256 WY 36(3):44 on Draba incerta.

PUCCINIA DURANGENSIS 1645 AZ M8(2):398 on Stipa pringlei.

PUCCINIA ELLISII 1459 WY 36(5):75 on Angelica arguta.

PUCCINIA ENCELIAE 1646 CO M8(2):398 on Viguiera multiflora.

PUCCINIA ERIOPHYLLI 1052 ID 24(3):28 on Eriophyllum lanatum.

PUCCINIA EVADENS 551 AZ 18(2):77 on Baccharis sarothroides.

PUCCINIA EXPANSA 1257 WY 36(3):44 on Senecio integerrimus.

PUCCINIA EXTENSICOLA 247 WY 7(3):34 on Agoseris glauca; 245 WY 7(3):34 on Aster sp.; 552 ID 18(2):77 on A. foliaceus; 323 WY 10(4):36 on A. frondeus; 324 WY 10(4):36 on Carex sp.; 248 WY 7(3):34 on C. festivella; 553 WY 18(2):77 on C. geyeri; 554 ID 18(2):77 on C. gravida; 246 WY 7(3):34 on Erigeron salsuginosus.

PUCCINIA FRANSERIAE 1649 AZ M8(2):398 on Ambrosia deltoidea; 1460 AZ 36(5):76, 1461 AZ 36(5):76 on Franseria deltoidea; 1647 AZ M8(2):398 on Hymenoclea monogyra; 1648 AZ M8(2):398 on H. pentalepis.

PUCCINIA FRASERI 1650 MT M8(2):398 on Hieracium albiflorum.

PUCCINIA GAYOPHYTI 249 WY 7(3):34 on Gayophytum racemosum; 250 MT

7(3):34 on G. ramosissimum.
PUCCINIA GENTIANAE 53 NM 1(8):225 on Gentiana affinis; 251 WY 7(3):34, 653 CO 21(4):149 on G. bigelovii; 750 CO 21(5):161 on G. parryi
PUCCINIA GIGANTISPORA 555 WY 18(2):77, 966 CO 23(4):47, 1053 WY 24 (3):28 on Anemone globosa; 1651 WY M8(2):398 on A. multifida.
PUCCINIA GLOBOSIPES 1462 AZ 36(5):75 on Lycium berlandieri; 556 AZ 18(2):77 on L. californicum; 1463 AZ 36(5):75 on L. exsertum; 1652 AZ M8(2):398 on L. fremontii.
PUCCINIA GRAMINIS 654 WY 21(4):149 on Agropyron smithii; 252 WY 7(3): 35 on A. subsecundum; 655 WY 21(4):149 on A. trachycaulum; 1653 MT M8(2):399 on Phleum pratense.
PUCCINIA GRANULISPORA 751 MT 21(5):161 on Allium cernuum.
PUCCINIA GRINDELIAE 1654 AZ M8(2):398 on Baileya multiradiata; 967 AZ 23(4):47 on Chrysopsis villosa; 557 CO 18(2):77, 558 NM 18(2):77, 752 MT 21(5):162 on Chrysothamnus nauseosus; 1258 WY 36(3):45 on C. viscidiflorus; 753 CO 21(5):162 on Erigeron caespitosus; 1656 WY M8(2):399 on E. eatonii; 1657 WY M8(2):399 on E. nematophyllus; 253 UT 7(3):35 on Grindelia sp.; 754 NM 21(5):162 on G. squarrosa; 1658 WY M8(2):399 on Gutierrezia sarothrae; 1655 AZ M8(2):399 on Haplopappus spinulosa; 1659 AZ M8(2):399 on Psilostrophe cooperi; 1259 WY 36(3):45 on Solidago elongata; 1260 WY 36(3):45 on S. multiradiata; 559 CO 18(2):77 on S. petradoria; 325 WY 10(4):31 on Stenotus acaulis; 54 WY 1(8):225 on Xylorrhiza glabriuscula; 55 WY 1(8):225, 1464 WY 36(5):75 on X. parryi.
PUCCINIA GROSSULARIAE 153 WY 3(3):94 on Carex variabilis; 154 WY 3(3): 94 on Ribes saxosum.
PUCCINIA GRUMOSA 155 WY 3(3):94 on Zygadenus elegans; 560 WY 18(2):78, 755 CO 21(5):162 on Z. gramineus.
PUCCINIA GUILLEMINEAE 968 AZ 23(4):47 on Brayulinea densa.
PUCCINIA HALENIAE 1261 WY 36(3):45 on Gentiana calycosa.
PUCCINIA HARKNESSII 326 AZ 10(4):36 on Ptiloria runcinata; 561 UT 18(2):78 on Stephanomeria tenuifolia.
PUCCINIA HELIANTHI 56 WY 1(8):226 on Helianthus annuus; 156 WY 3(3):94 on H. fascicularis.
PUCCINIA HELIANTHELLAE 1262 WY 36(3):45, 1660 WY M8(2):399 on Helianthella quinquenervis; 254 WY 7(3):35 on H. uniflora.
PUCCINIA HETEROSPORA 1465 AZ 36(5):75 on Abutilon californicum; 1466 AZ 36(5):76 on Bogenhardia crispa.
PUCCINIA HEUCHERAE 757 CO 21(5):162 on Heuchera bracteata; 157 WY 3(3):94, 756 CO 21(5):162, 1054 WY 24(3):28, 1263 WY 36(3):45 on Mitella pentandra; 1056 WY 24(3):28 on M. stauropetala; 158 WY 3(3): 94, 1055 WY 24(3):28, 1661 WY M8(2):399 on Saxifraga arguta; 758 MT 21(5):162 on S. lyallii; 759 MT 21(5):162 on S. rhomboidea.
PUCCINIA HIERACII 562 WY 18(2):78, 760 CO 21(5):162, 1089 WY 24(3):32, 1264 WY 36(3):45 on Agoseris glauca; 58 UT 1(8):226 on A. parviflora; 1662 CO M8(2):399 on Crepis acuminata; 761 MT 21(5):163 on Hieracium albertinum; 1467 WY 36(5):76 on H. albiflorum; 1663 WY M8(2):399 on Lygodesmia juncea; 57 CO 1(8):226, 159 WY 3(3):94, 563 ID 18(2):78, 1057 WY 24(3):28, 1468 MT 24(3):28 on Taraxacum officinale; 762 MT 21(5):163 on T. vulgare.
PUCCINIA HOLBOELLII 255 WY 7(3):35 on Arabis lignipes; 59 CO 1(8):226, 160 WY 3(3):94 on Schoenocrambe linifolia.
PUCCINIA HYDROPHYLLI 1265 UT 36(3):45 on Hydrophyllum fendleri; 1664 WY M8(2):399 on Mertensia ciliata.
PUCCINIA INANIPES 1665 AZ M8(2):399 on Eupatorium solidaginifolium.
PUCCINIA INTERMIXTA 60 WY 1(8):226, 1469 ID 36(5):77 on Iva axillaris.

PUCCINIA IRIDIS 564 CO 18(2):78, 1470 AZ 36(5):77 on Iris missouriensis; 256 WY 7(3):35 on I. pelogonus.

PUCCINIA JONESII 763 MT 21(5):163 on Leptotaenia multifida; 257 WY 7(3):35 on Ligusticum simulans; 1266 WY 36(3):45 on Lomatium dissectum.

PUCCINIA KOELERIAE 1058 WY 24(3):28 on Berberis repens.

PUCCINIA KUHNIAE 1471 AZ 36(5):77 on Brickellia amplexicaulis; 565 AZ 18(2):78, 969 AZ 23(4):47 on B. lemmonii; 566 AZ 18(2):78 on Kuhnia rosmarinifolia.

PUCCINIA LASCHII 1666 AZ M8(2):399 on Cirsium sp.

PUCCINIA LEVEILLEI 258 WY 7(3):35 on Geranium fremontii.

PUCCINIA LIATRIDIS 826 AZ 23(3):27 on Brickellia grandiflora; 827 AZ 23(3):27 on Koeleria cristata.

PUCCINIA LIGUSTICI 1267 UT 36(3):46 on Angelica pinnata; 259 WY 7(3):35 on Conioselinum scopulorum; 260 WY 7(3):35 on Ligusticum simulans; 1667 CO M8(2):399 on Oxypolis fendleri.

PUCCINIA MCCLATCHIEANA 45 WY 1(8):224 on Scirpus microcarpus.

PUCCINIA MALVACEARUM 261 WY 7(3):36 on Althaea rosea; 161 WY 3(3):94 on Malva rotundifolia.

PUCCINIA MENTHAE 62 WY 1(8):226 on Mentha canadensis; 971 AZ 23(4):47 on M. spicata; 656 WY 21(4):149 on Monarda fistulosa; 61 CO 1(8):226, 567 NM 18(2):78, 764 MT 21(5):163, 970 AZ 23(4):47 on M. menthaefolia.

PUCCINIA MESOMAJALIS 765 MT 21(5):163 on Clintonia uniflora.

PUCCINIA MICRANTHA 828 CO 23(3):27 on Oryzopsis micrantha.

PUCCINIA MILLEFOLII 657 WY 21(4):149 on Achillea millefolium; 262 NM 7(3):36 on Artemisia dracunculoides, 51 WY 1(8):225 on A. gnaphalodes.

PUCCINIA MINUSSENSIS 766 MT 21(5):163, 1059 WY 24(3):29, 1060 WY 24(3):29, 1472 WY 36(5):77, 1668 WY M8(2):399 on Lactuca pulchella.

PUCCINIA MONOICA 327 CO 10(4):36 on Arabis sp.; 328 WY 10(4):36 on A. drummondii; 830 MT 23(3):28, 1061 WY 24(3):29 on A. holboellii; 831 MT 23(3):28, 832 CO 23(3):28 on Koeleria cristata; 833 AZ 23(3):28 on Oryzopsis hymenoides; 1268 WY 36(3):46 on Poa secunda; 63 WY 1(8):226 on Schoenocrambe linifolia; 1669 CO M8(2):399 on Thlaspi montanum; 829 CO 23(3):27 on Trisetum spicatum.

PUCCINIA MONTANENSIS 1473 WY 36(5):77 on Agropyron smithii; 1270 WY 36(3):46 on A. spicatum; 659 WY 21(4):149, 658 WY 21(4):149 on A. trachycaulum; 1269 WY 36(3):46 on Berberis repens; 834 AZ 23(3):28 on Sitanion hystrix.

PUCCINIA MUSENII 1271 WY 36(3):46 on Lomatium montanum.

PUCCINIA MUTABILIS 767 MT 21(5):163 on Allium rubrum.

PUCCINIA NEOCORONATA 835 AZ 23(3):28 on Piptochaetium fimbriatum.

PUCCINIA NODOSA 1474 AZ 36(5):77 on Dichelostemma pulchellum.

PUCCINIA OBTECTA 64 WY 1(8):226 on Scirpus americanus.

PUCCINIA OENOTHERAE 1670 AZ M8(2):399 on Camissonia californica; 1062 WY 24(3):29 on Oenothera heterantha.

PUCCINIA PALLIDISSIMA 1671 AZ M8(2):400 on Stachys coccinea.

PUCCINIA PALMERI 568 ID 18(2):78 on Penstemon sp.; 768 MT 21(5):163 on P. confertus; 769 MT 21(5):163 on P. ellipticus; 1272 WY 36(3):46, 1063 WY 24(3):29 on P. procerus.

PUCCINIA PARKERAE 770 MT 21(5):163 on Ribes lacustre.

PUCCINIA PARNASSIAE 771 MT 21(5):163 on Parnassia fimbriata.

PUCCINIA PATTERSONIANA 569 MT 18(2):79 on Agropyron spicatum.

PUCCINIA PENTSTEMONIS 972 AZ 23(4):47 on Penstemon bridgesii; 263 AZ 7(3):36 on P. connatifolius; 1273 WY 36(3):46 on P. deustus;

1672 AZ M8(2):400 on P. pinifolius.

PUCCINIA PIMPINELLAE 264 WY 7(3):36, 1064 WY 24(3):29 on Osmorhiza obtusa; 1065 WY 24(3):29 on O. occidentalis.

PUCCINIA PLUMBARIA 329 ID 10(4):36, 1066 WY 24(3):29 on Phlox longifolia; 265 WY 7(3):36 on P. multiflora.

PUCCINIA POAE-NEMORALIS 1067 WY 24(3):29 on Catabrosa aquatica; 836 AZ 23(3):28 on Festuca ovina; 1068 WY 24(3):29 on Phleum pratense; 837 CO 23(3):29 on Poa interior; 838 CO 23(3):29 on P. leptocoma; 1069 WY 24(3):30 on P. palustris; 839 AZ 23(3):29 on P. pratensis; 840 CO 23(3):29 on P. reflexa.

PUCCINIA POAE-SUDETICAE 570 WY 18(2):79 on Poa palustris.

PUCCINIA POARUM 1673 UT M8(2):400 on Helenium hoopesii.

PUCCINIA POCULIFORME 66 CO 1(8):227 on Agropyron tenerum; 65 CO 1(8):226 on Avena fatua.

PUCCINIA POLYGONI-AMPHIBII 162 WY 3(3):94 on Polygonum sp.

PUCCINIA PORPHYROGENITA 571 MT 18(2):79 on Cornus canadensis.

PUCCINIA PSEUDOCYMOPTERI 266 WY 7(3):36, 572 CO 18(2):79, 973 AZ 23(4):47 on Pseudocymopterus montanus; 330 WY 10(4):36 on P. sylvaticus.

PUCCINIA PULVERULENTA 1070 WY 24(3):30, 1071 WY 24(3):30 on Epilobium paniculatum; 772 CO 21(5):164, 1072 WY 24(3):30 on Gayophytum nuttallii; 974 AZ 23(4):48 on G. racemosum; 975 AZ 23(4):48 on G. ramosissimum.

PUCCINIA PUNCTATA 773 MT 21(5):164 on Galium triflorum.

PUCCINIA PUNCTIFORMIS 660 WY 21(4):149, 774 MT 21(5):164, 1674 WY M8(2):400 on Cirsium arvense.

PUCCINIA PYGMAEA 841 CO 23(3):29 on Berberis repens; 842 CO 23(3):29; 843 AZ 23(3):29 on Koeleria cristata.

PUCCINIA RECONDITA 1082 WY 24(3):31 on Agropyron albicans; 855 AZ 23(3):31 on A. arizonicum; 850 MT 23(3):30 on A. dasystachyum; 1279 WY 36(3):47 on A. griffithsii; 1477 WY 36(5):77 on A. inerme; 856 CO 23(3):31 on A. pseudorepens; 849 MT 23(3):30, 1281 WY 36(3):48, 1678 CO M8(2):400 on A. spicatum;662 UT 21(4):150, 845 CO 23(3):30, 847 CO 23(3):30, 852 CO 23(3):31, 854 CO 23(3):31, 857 AZ 23(3):31, 1083 WY 24(3):31 on A. trachycaulum; 976 CO 23(4):48 on Anemone cylindrica; 844 CO 23(3):29, 1073 WY 23(3):30, 1074 WY 24(3):30, 1274 WY 36(3):46 on Aquilegia coerulea; 977 MT 23(4):48, 1075 ID 24(3):30 on A. formosa; 1248 WY 36(3):43 on Bromus anomalus; 859 CO 23(3):31, 860 CO 23(3):32, 861 AZ 23(3):32, 862 AZ 23(3):32, 1084 WY 24(3):31, 1280 WY 36(3):47 on B. ciliatus; 863 AZ 23(3):32, 864 AZ 23(3):32 on B. frondosus; 1085 WY 24(3):31 on B. marginatus; 865 CO 23(3):32 on B. polyanthus; 846 CO 23(3):30, 1076 WY 24(3):30 on Clematis hirsutissima; 848 MT 23(3):30, 866 MT 23(3):32, 868 CO 23(3):32, 1675 CO M8(2):400 on C. ligusticifolia; 1676 CO M8(2):400 on Delphinium sp.; 851 CO 23(3):30 on D. geyeri; 1077 WY 24(3):30, 1078 ID 24(3):30 on D. occidentale; 878 CO 23(3):34 on Elymus canadensis; 663 WY 21(4):150, 867 MT 23(3):32, 869 CO 23(3):33 on E. cinereus; 871 CO 23(3):33, 873 CO 23(3):33, 875 CO 23(3):33, 877 MT 23(3):34, 1086 WY 24(3):31, 1276 WY 36(3):47, 1278 WY 36(3):47 on E. glaucus; 880 CO 23(3):34 on Festuca thurberi; 1079 WY 24(3):31, 1475 UT 36(5):77, 1677 WY M8(2):400 on Hydrophyllum capitatum; 853 CO 23(3):31, 870 CO 23(3):33 on H. fendleri; 1080 WY 24(3):31 on Phacelia heterophylla; 881 AZ 23(3):34 on Sitanion hystrix; 661 UT 21(4):150, 858 CO 23(3):31, 872 CO 23(3):33, 879 CO 23(3):34, 978 AZ 23(4):48, 1476 ID 36(5):77 on Thalictrum fendleri;

874 CO 23(3):33, 976 MT 23(3):34, 1081 WY 24(3):31, 1275 WY 36(3):47, 1277 WY 36(3):47 on T. occidentale; 882 CO 23(3):34, 979 WY 23(4):48, 1087 WY 24(3):32 on Trisetum spicatum.

PUCCINIA REDFIELDIAE 883 CO 23(3):35 on Oenothera nuttallii; 884 CO 23(3):35 on Redfieldia flexuosa.

PUCCINIA RETECTA 775 CO 21(5):164, 1282 CO 36(3):48, 1283 WY 36(3):48 on Anemone zephyra.

PUCCINIA RUBEFACIENS 776 CO 21(5):164, 777 MT 21(5):164, 1284 WY 36(3):48, 1285 WY 36(3):48 on Galium boreale.

PUCCINIA RUBELLA 163 WY 3(3):95 on Phragmites communis.

PUCCINIA RUBIGO-VERA 574 WY 18(2):79 on Agropyron subsecundum; 575 CO 18(2):79 on A. trachycaulum; 267 WY 7(3):36 on Aquilegia coerulea; 576 WY 18(2):79 on Bromus carinatus; 333 WY 10(4):37, 577 AZ 18(2):79 on B. ciliatus; 268 WY 7(3):36 on Clematis ligusticifolia; 331 WY 10(4):36 on Delphinium geyeri; 578 ID 18(2):79 on Elymus condensatus; 270 WY 7(3):36, 579 CO 18(2):80 on E. glaucus; 573 WY 18(2):79 on Phacelia leucophylla; 332 WY 10(4):36 on Ranunculus cymbalaria; 580 CO 18(2):80 on Sitanion hystrix; 269 WY 7(3):36 on Thalictrum occidentale; 581 WY 18(2):80 on Trisetum spicatum.

PUCCINIA RUFESCENS 1478 AZ 36(5):78 on Pedicularis centranthera.

PUCCINIA SARCOBATI 67 WY 1(8):227 on Distichlis spicata.

PUCCINIA SCABER 582 CO 18(2):80 on Stipa robusta;

PUCCINIA SCHEDONNARDI 583 AZ 18(2):80, 885 AZ 23(3):35 on Lycurus phleoides; 584 NM 18(2):80 on Muhlenbergia asperifolia; 886 CO 23(3):35 on M. montana; 980 CO 23(4):48 on Sphaeralcea coccinea.

PUCCINIA SENECIONIS 1679 CO on Senecio crassulus.

PUCCINIA SHERARDIANA 1286 WY 36(3):48 on Althaea rosea; 271 WY 7(3):37 on Malvastrum coccineum; 1479 AZ 36(5):78 on Sphaeralcea angustifolia; 981 NM 23(4):48 on S. coccinea; 1481 AZ 36(5):79 on S. coulteri; 585 NM 18(2):80, 1480 AZ 36(5):78 on S. emoryi; 982 AZ 23(4):48 on S. fendleri; 1482 AZ 36(5):78 on S. laxa; 68 NM 1(8):227 on S. lobata; 586 AZ 18(2):80 on S. marginata.

PUCCINIA SPARGANIOIDES 1483 WY 36(5):78 on Spartina pectinata.

PUCCINIA SPLENDENS 587 NV 18(2):80 on Hymenoclea fasciculata; 588 AZ 18(2):81, 1484 AZ 36(5):78 on H. monogyra.

PUCCINIA SPOROBOLI 887 CO 23(3):35 on Calamovilfa longifolia.

PUCCINIA STIPAE 889 MT 23(3):36 on Chrysopsis villosa; 1680 WY M8(2):400 on Chrysothamnus visidiflorus; 888 MT 23(3):35 on Erigeron corymbosus; 891 CO 23(3):36 on Gutierrezia sarothrae; 334 WY 10(4):37 on Senecio integerrimus; 272 WY 7(3):37 on S. perplexus; 893 AZ 23(3):36 on Solidago nana; 273 WY 7(3):37, 890 MT 23(3):36, 892 CO 23(3):36, 894 AZ 23(3):36, 1088 WY 24(3):32 on Stipa comata; 589 AZ 18(2):81 on S. pringlei.

PUCCINIA SUBCIRCINATA 335 WY 10(4):37, 983 CO 23(4):48 on Senecio crassulus.

PUCCINIA SUBDECORA 1681 WY M8(2):400 on Brickellia grandiflora.

PUCCINIA SUBNITENS 164 CO 3(3):95 on Plantago eriopoda.

PUCCINIA SUBSTERILIS 895 CO 23(3):36, 1287 WY 36(3):48 on Oryzopsis hymenoides; 664 WY 21(4):150 on Stipa columbiana; 896 AZ 23(3):36, 897 CO 23(3):37 on S. lettermanii; 984 NM 23(4):49 on S. scribneri; 898 CO 23(3):37 on S. viridula.

PUCCINIA SUKSDORFII 274 WY 7(3):37, 778 CO 21(5):164, 779 MT 21(5):164, 1089 WY 24(3):32 on Agoseris glauca.

PUCCINIA SWERTIAE 780 CO 21(5):165 on Swertia perennis.

PUCCINIA SYMPHORICARPI 590 MT 18(2):81 on Symphoricarpos albus; 781 MT 21(5):165 on S. occidentalis.

PUCCINIA TANACETI 1486 WY 36(5):78, 1487 WY 36(5):78 on Artemisia cana; 782 CO 21(5):165, 985 AZ 23(4):49 on A. dracunculoides; 665 WY 21(4):150 on A. dracunculus; 666 WY 21(4):150 on A. ludoviciana; 667 UT 21(4):150, 668 CO 21(4):150, 783 MT 21(5):165, 986 AZ 23(4):49, 1485 ID 36(5):78 on A. tridentata.
PUCCINIA TETRAMERII 1682 AZ M8(2):400 on Tetramerium hispidum.
PUCCINIA THLASPEOS 1288 WY 36(3):48 on Arabis drummondii; 784 MT 21(5):165, 1090 WY 24(3):32, 1289 WY 36(3):48 on A. holboellii; 1091 WY 24(3):32 on A. lignifera; 785 MT 21(5):165 on A. lyallii; 786 MT 21(5):165 on A. microphylla.
PUCCINIA TRELEASIANA 787 CO 21(5):165, 1290 WY 36(3):48 on Caltha leptosepala.
PUCCINIA TUMIDIPES 591 CO 18(2):81, 1488 AZ 36(5):79 on Lycium pallidum.
PUCCINIA URTICATA 275 WY 7(3):37 on Carex nebraskensis; 276 WY 7(3):37 on C. rostrata.
PUCCINIA VAGANS 1489 WY 36(5):79 on Epilobium paniculatum.
PUCCINIA VERATRI 788 MT 21(5):165 on Epilobium alpinum; 1683 CO M8(2):400 on Veratrum californicum.
PUCCINIA VERSICOLOR 1490 AZ 36(5):79 on Heteropogon contortus.
PUCCINIA VERTISEPTA 277 AZ 7(3):37 on Salvia pinguifolia.
PUCCINIA VEXANS 592 AZ 18(2):81, 900 AZ 23(3):37 on Bouteloua curtipendula; 899 AZ 23(3):37 on Fouquieria splendens.
PUCCINIA VIOLAE 789 CO 21(5):165 on Viola sp.; 593 NM 18(2):81, 1291 UT 36(3):49 on V. canadensis; 165 WY 3(3):95 on V. rydbergii.
PUCCINIA WULFENIAE 1292 WY 36(3):49 on Veronica wormskjoldii.
PUCCINIA XANTHII 1684 AZ M8(2):400 on Ambrosia confertifolia; 1685 AZ M8(2):400 on A. psilostachya; 69 WY 1(8):227 on Xanthium echinatum.
PUCCINIASTRUM EPILOBII 1211 WY 36(3):39 on Abies lasiocarpa; 1417 WY 36(5):71 on Epilobium sp.; 1614 WY M8(2):396 on E. adenocaulon; 1212 WY 36(7):39, 1418 WY 36(5):71, 1419 AT 36(5):71 on E. angustifolium; 1213 WY 36(3):39 on E. glandulosum; 1018 WY 24(3):24, 1019 ID 24(3):24 on E. hornemannii.
PUCCINIASTRUM GOEPPERTIANUM 223 WY 7(3):32, 1020 WY 24(3):24, 1214 WY 36(3):39, 1420 ID 36(5):71 on Abies lasiocarpa; 634 CO 21(4):146 on Vaccinium sp.; 1615 WY M8(2):396 on V. caespitosum; 224 WY 7(3):32, 511 ID 18(2):72, 1421 ID 36(5):71 on V. membranaceum; 134 WY 3(3):92, 635 UT 21(4):147, 1021 WY 24(3):24, 1215 WY 36(3):39 on V. scoparium.
PUCCINIASTRUM MYRTILLI 225 WY 7(3):32 on Vaccinium membranaceum; 135 WY 3(3):92 on V. oreophilum; 512 WY 18(2):72 on V. scoparium.
PUCCINIASTRUM PUSTULATUM 136 WY 3(3):92 on Epilobium adenocaulon.
PUCCINIASTRUM PYROLAE 708 MT 21(5):157 on Chimaphila umbellata; 226 WY 7(3):32 on Pyrola secunda; 1616 WY M8(2):396 on P. virens.
PUCCINIASTRUM VACCINII 1422 WY 36(5):71 on Vaccinium caespitosum; 709 MT 21(5):157 on V. membranaceum; 1216 WY 36(3):39 on V. scoparium.
PYRENOPHORA PHAEOSPORA 127 WY 3(3):91 on Arenaria sajanensis.
RAMULARIA ACTAEAE 1172 WY 24(4):47 on Actaea arguta.
RAMULARIA ADOXAE 1590 CO M8(2):393 on Adoxa moschatellina.
RAMULARIA ANGELICAE 1173 WY 24(4):47, 1384 WY 36(4):65 on Angelica arguta.
RAMULARIA ARVENSIS 396 WY 10(4):45, 694 CO 21(4):154 on Potentilla arguta; 94 WY 1(8):231 on P. gracilis; 1591 WY M8(2):393 on P. norvegica; 1174 WY 24(4):47 on P. pulcherrima.
RAMULARIA ASTERIS 1175 WY 24(4):47, 1176 WY 24(4):47 on Aster folia-

ceus; 298 WY 7(3):42 on A. fremontii.

RAMULARIA CASTILLEJAE 1177 WY 24(4):47 on Castilleja miniata.

RAMULARIA CERCOSPOROIDES 194 WY 3(3):99 on Epilobium angustifolium.

RAMULARIA DECIPIENS 95 WY 1(8):231 on Rumex sp.; 299 WY 7(3):42 on R. venosus.

RAMULARIA GAYOPHYTI 1178 WY 24(4):48 on Gayophytum diffusum.

RAMULARIA GEI 495 WY 15(1):25 on Geum macrophyllum.

RAMULARIA HELIANTHI 1385 WY 36(4):65 on Helianthella quinquenervis.

RAMULARIA HERACLEI 195 WY 3(3):99, 300 WY 7(3):42 on Heracleum lanatum.

RAMULARIA IONOPHILA 397 WY 10(4):45 on Viola linguaefolia; 1592 UT M8 (2):393, 1593 ID M8(2):393 on V. nuttallii; 1386 WY 36(4):65 on V. vallicola.

RAMULARIA LONICERAE 695 WY 21(4):154 on Lonicera utahensis.

RAMULARIA LOPHANTHI 696 WY 21(4):154, 697 ID 21(4):154 on Agastache urticifolia.

RAMULARIA MENTHICOLA 1179 WY 24(4):48, 1362 WY 36(4):6, 1595 ID M8 (2):393 on Mentha arvensis; 398 WY 10(4):45 on M. canadensis.

RAMULARIA NIVOSA 1387 ID 36(4):65 on Penstemon sp.

RAMULARIA OBDUCENS 1180 WY 24(4):48 on Pedicularis paysoniana.

RAMULARIA PHACELIAE 496 WY 15(1):26 on Phacelia leucophylla.

RAMULARIA PRUINOSA 698 WY 21(4):154 on Senecio rapifolius; 1388 WY 36(4):66 on S. serra; 96 WY 1(8):231 on S. triangularis.

RAMULARIA PUNCTIFORMIS 1181 WY 24(4):48-50 on Epilobium adenocaulon; 1389 WY 36(4):66, 1390 UT 36(4):66, 1594 ID M8(2):393 on E. angustifolium.

RAMULARIA RUDBECKIAE 196 WY 3(3):99 on Rudbeckia laciniata; 1182 WY 24(4):50 on R. occidentalis.

RAMULARIA SAXIMONTANENSIS 399 WY 10(4):45, 1183 WY 24(4):50 on Clematis columbiana.

RAMULARIA SENECIONIS 1184 WY 24(4):50 on Senecio hydrophiloides; 1185 WY 24(4):50 on S. integerrimus.

RAMULARIA SEROTINA 1596 WY M8(2):393 on Solidago canadensis; 699 WY 21(4):154, 1186 WY 24(4):50 on S. lepida; 1391 WY 36(4):66 on S. missouriensis; 197 WY 3(3):99 on S. serotina.

RAMULARIA SHELDONII 1187 WY 24(4):51, 1597 ID M8(2):393 on Delphinium occidentale.

RAMULARIA SILVESTRIS 1598 UT M8(2):394 on Dipsacus silvestris.

RAMULARIA SMILACINAE 400 WY 10(4):46 on Smilacina amplexicaulis.

RAMULARIA TARAXACI 497 CO 15(1):26, 1188 WY 24(4):51 on Taraxacum officinale.

RAMULARIA TRIFOLII 1189 WY 24(4):51 on Trifolium longipes; 1392 WY 36(4):66 on T. rydbergii.

RAVENELIA CASSIAE-COVESII 1491 AZ 36(5):79 on Cassia covesii.

RAVENELIA INDIGOFERAE 1492 AZ 36(5):79 on Indigofera sphaerocarpa.

RAVENELIA RETICULATAE 1686 AZ M8(2):400 on Calliandra reticulata.

RAVENELIA VERSATILIS 1493 AZ 36(5):79 on Acacia greggii.

RHABDOCLINE PSEUDOTSUGAE 1135 ID 24(4):40 on Pseudotsuga taxifolia.

RHABDOGLOEUM PSEUDOTSUGAE 1379 WY 36(4):64 on Pseudotsuga menziesii.

RHYTISMA PUNCTATUM 618 UT 21(4):145 on Acer grandidentatum.

RHYTISMA SALICINUM 1342 ID 36(4):57 on Salix sp.; 1204 WY 36(3):38 on S. anglorum; 619 WY 21(4):145 on S. exigua; 9 WY 1(8):220 on S. fluviatilis; 1343 WY 36(4):57 on S. monticola; 10 WY 1(8):220 on S. scouleriana.

SCAPHIDIUM BOUTELOUAE 1562 NM M8(2):390 on Bouteloua curtipendula.

SCHIZONELLA MELANOGRAMMA 213 WY 7(3):30 on Carex aquatilis; 310 WY

10(4):34 on C. nigricans; 311 WY 10(4):34 on C. pseudoscirpoidea.
SCLEROTINIA CARICIS-AMPULLACEAE 204 WY 7(3):29 on Carex aquatilis.
SCLEROTIUM BIFRONS 100 WY 1(8):232 on Populus tremuloides.
SCOLECOTRICHUM GRAMINIS 200 WY 3(3):99 on Hordeum jubatum; 500 NM 15(1):27 on Sitanion hystrix.
SECOTIUM AGARICOIDES 1557 CO M8(2):390 on ground.
SELENOPHOMA DONACIS 469 CO 15(1):16 on Agropyron inerme.
SEPTOGLOEUM HEDYSARI 390 WY 24(4):45 on Hedysarum marginatum.
SEPTOGLOEUM OXYSPORUM 1166 WY 24(4):45 on Calamagrostis sp.; 1156 WY 24(4):42 on C. canadensis.
SEPTOGLOEUM RHOPALOIDEUM 1572 WY M8(2):391 on Populus tremuloides.
SEPTOGLOEUM SALICIS-FENDLERIANAE 391 WY 10(4):43 on Salix lasiandra.
SEPTORIA AGROPYRI 85 WY 1(8):229 on Agropyron spicatum.
SEPTORIA APII 86 CO 1(8):229 on Apium graveolens.
SEPTORIA ARABIDIS 87 WY 1(8):229, 182 CO 3(3):97 on Arabis exilis.
SEPTORIA ASTRAGALICOLA 183 WY 3(3):97 on Astragalus nitidus.
SEPTORIA AVENAE 686 CO 21(4):153 on Glyceria striata.
SEPTORIA BAUDYSIANA 185 WY 3(3):97 on Carex aquatilis; 184 WY 3(3):97 on C. vesicaria.
SEPTORIA COMMERSONIANA 1195 WY 24(4):53 on Cerastium arvense
SEPTORIA CONVOLVULI 88 WY 1(8):230 on Convolvulus arvensis.
SEPTORIA GUARINA 472 AZ 15(1):17 on Zauschneria californica.
SEPTORIA HELIANTHI 186 WY 3(3):98 on Helianthus annuus.
SEPTORIA MENTHICOLA 89 WY 1(8):230 on Mentha canadensis.
SEPTORIA OEDOSPORA 1365 WY 36(4):61 on Symphoricarpos oreophilus.
SEPTORIA PETROSELINI 473 WY 15(1):17 on Conioselinum scopulorum.
SEPTORIA POLEMONII 1366 WY 36(4):61 on Polemonium occidentale.
SEPTORIA POLYGONORUM 687 WY 21(4):153 on Polygonum persicaria.
SEPTORIA POPULI 187 WY 3(3):98 on Populus tacamahaca.
SEPTORIA PURPURASCENS 1161 WY 24(4):44 on Potentilla gracilis.
SEPTORIA RIBIS 188 WY 3(3):98 on Ribes saxosum.
SEPTORIA RUMICIS 289 WY 7(3):39 on Rumex venosus.
SEPTORIA SAMBUCINA 474 CO 15(1):18 on Sambucus sp.
SEPTORIA SCUTELLARIAE 1563 ID M8(2):391 on Scutellaria galericulata.
SEPTORIA SIBERICA 1564 WY M8(2):391 on Ribes inerme.
SEPTORIA SIGNALENSIS 1565 WY M8(2):391 on Symphoricarpos albus; 290 WY 7(3):39 on S. oreophilus; 1566 ID M8(2):391 on S. vaccinioides.
SEPTORIA SII 189 WY 3(3):98 on Cicuta occidentalis.
SEPTORIA URTICAE 1567 AZ M8(2):391 on Urtica gracilenta.
SEPTORIA VERBENAE 475 AZ 15(1):18 on Verbena scabra.
SEPTORIA VIOLAE 476 NM 15(1):18 on Viola sp.
SEPULTARIA AURANTIA 301 CO 10(4):33 on ground.
SOROSPORIUM ASTRAGALI 132 WY 3(3):92 on Lupinus plattensis.
SOROSPORIUM CONSANGUINEUM 440 AZ 15(1):9 on Aristida orcuttiana.
SPHACELOTHECA INFLORESCENTIAE 441 WY 15(1):9 on Polygonum viviparum.
SPHACELOTHECA SORGHI 442 AZ 15(1):10 on Sorghum halepense.
SPHAEROTHECA FULIGINEA 1531 CO M8(2):388 on Pedicularis bracteosa.
SPHAEROTHECA HUMULI 612 WY 21(4):144 on Agoseris glauca; 1322 AZ 36(4):54 on Allophyllum gilioides; 115 WY 3(3):90 on Arnica foliosa; 19 WY 1(8):221, 1125 WY 24(4):38 on Astragalus alpinus; 1126 WY 24(4):38 on Castilleja miniata; 1127 WY 24(4):38 on Collinsia parviflora; 306 WY 10(4):34, 1323 WY 36(4):55 on Collomia liniaris; 208 WY 7(3):30 on Geranium fremontii; 610 UT 21(4):143, 1324 ID 36(4):55 on G. nervosum; 1128 WY 24(4):39 on G. viscosissimum; 420 CO 15(1):4 on Geum macrophyllum; 307 WY 10(4):34 on Pedicularis paysoniana; 1124 WY 24(4):38 on Phlox longifolia; 209 WY 7(3):30

on Plantago eriopoda; 114 WY 3(3):90 on Saxifraga arguta; 424 UT 15(1):5 on Senecio spartioides; 116 WY 3(3):90 on S. triangularis; 423 WY 15(1):5 on Synthyris wyomingensis; 421 CO, 422 nm 15(1):4, 1325 WY 36(4):55 on Taraxacum officinale; 18 WY 1(8):221 on Viola canadensis; 611 WY 21(4):143 on V. rugulosa; 1129 WY 24(4):39 on Wyethia helianthoides.

SPORONEMA PUNCTIFORME 1162 WY 24(4):44, 1367 WY 36(4):61 on Galium boreale.

STAGONOSPORA FOLICOLA 1156 WY 24(4):42 on Calamagrostis canadensis.

STAGONOSPORA MELILOTI 688 ID 21(4):153 on Melilotus alba.

STEREUM HIRSUTUM 350 WY 10(4):38, 453 CO 15(1):11 on Alnus tenuifolia.

STEREUM RUFUM 351 WY 10(4):38, 352 CO 10(4):38 on Populus tremuloides.

STEREUM RUGISPORUM 353 WY 10(4):39 on Picea engelmannii.

STEREUM SANGUINOLENTUM 354 WY 10(4):39 on wood.

SYNCARPELLA TUMEFACIENS 1532 WY M8(2):388 on Artemisia tridentata.

SYNCHYTRIUM SP. 1101 WY 24(4):34 on Collinsia parviflora.

SYNCHYTRIUM EPILOBII 1102 WY 24(4):34 on Epilobium lactiflorum.

TAPHRINA CAERULESCENS 103 WY 3(3):89 on Quercus gambellii.

TAPHRINA CONFUSA 1115 WY 24(4):36 on Prunus virginiana.

TEICHOSPORA NEGUNDINIS 27 CO 1(8):222 on Acer glabrum.

THELEPHORA CARYOPHYLLEA 355 CO 10(4):39 on ground.

TILLETIA ASPERIFOLIA 215 WY 7(3):31 on Muhlenbergia asperifolia.

TILLETIA ELYMI 1348 WY 36(4):58 on Elymus glaucus.

TITAEOSPORA DETOSPORA 193 WY 3(3):98 on Equisetum laevigatum.

TORULA HERBARUM 1599 CO M8(2):394 on Yucca sp.

TRAMETES HISPIDA 371 CO 10(4):40 on Populus tremuloides.

TRAMETES ISABELLINA 372 CO 10(4):40 on Picea engelmannii.

TRAMETES MOLLIS 373 WY 10(4):40 on wood.

TRANZSCHELIA COHAESA 1687, 1688, 1689 AZ M8(2):400 on Anemone tuberosa.

TRANZSCHELIA PRUNI-SPINOSAE 1494 AZ 36(5):79 on Prunus virens.

TRANZSCHELIA THALICTRI 669 UT 21(4):150, 790 CO 21(5):166 on Thalictrum fendleri.

TUBERCULINA PERSICINA 1600 NV M8(2):394 on Puccinia aristidae.

TYPHULOCHAETA JAPONICA 1326 AZ 36(4):55 on Quercus arizonica.

UNCINULA SALICIS 425 CO 15(1):5, 1130 WY 24(4):39 on Populus balsamifera; 20 WY 1(8):222 on P. tremuloides; 614 WY 21(4):144 on Salix amygdaloides; 1327 WY 36(4):55 on S. monticola; 615 WY 21(4):144 on S. pseudocordata; 21 WY 1(8):222 on S. scouleriana.

UREDINOPSIS GLABRA 925 AZ 23(4):41 on Cystopteris fragilis.

UREDINOPSIS PTERIDIS 710 MT 21(5):157 on Abies grandis; 711 MT 21(5):157, 1617 AZ M8(2):396 on Pteridium aquilinum.

UREDINOPSIS STRUTHIOPTERIDIS 712 MT 21(5):158, 713 MT 21(5):158 on Abies lasiocarpa.

UROCYSTIS AGROPYRI 1349 WY 36(4):58 on Elymus glaucus.

UROMYCES ACUMINATUS 670 WY 21(4):151 on Smilacina stellata.

UROMYCES AEMULUS 1495 ID 36(5):79 on Allium brandegei; 791 WY 21(5):166, 1092 WY 24(3):32, 1093 WY 24(3):32 on A. brevistylum.

UROMYCES AMOENUS 792 MT 21(5):166 on Anaphalis margaretacea.

UROMYCES CARNEUS 70 WY 1(8):227 on Astragalus alpinus.

UROMYCES COLORADENSIS 278 WY 7(3):37, 793 MT 21(5):166, 1293 UT 36(3):49 on Vicia americana.

UROMYCES DACTYLIDIS 987 CO 23(4):49 on Festuca ovina; 1094 WY 24(3):32 on Poa canbyi.

UROMYCES EPICAMPIS 988 AZ 23(4):49 on Muhlenbergia ringens.

UROMYCES ERAGROSTIDIS 594 AZ 18(2):81 on Eragrostis intermedia.

UROMYCES EUPHORBIAE 671 WY 21(4):151, 989 AZ 23(4):49 on Euphorbia glyptosperma.

UROMYCES FABAE 990 AZ 23(4):50 on Lathyrus arizonicus; 336 NM 10(4):37 on L. decaphyllus; 991 AZ 23(4):50 on L. eucosmus; 992 AZ 23(4):50 on L. laetivirens; 672 UT 21(4):151 on L. lanswertii; 673 WY 21(4):151 on L. polymorphus; 794 MT 21(5):166 on Vicia americana.

UROMYCES GLYCYRRHIZAE 71 WY 1(8):227, 337 NM 10(4):37, 993 CO 23(4):50, 1294 WY 36(3):49, 1496 MT 36(5):79, 1690 UT M8(2):401 on Glycyrrhiza lepidota.

UROMYCES HEDYSARI-OBSCURI 795 MT 21(5):166 on Hedysarum boreale; 279 WY 7(3):37 on H. marginatum; 595 WY 18(2):81, 1095 WY 24(3):32, 1096 WY 24(3):33 on H. occidentale; 72 WY 1(8):227 on H. pabulare; 796 MT 21(5):166, 1295 WY 36(3):49 on H. sulphurescens

UROMYCES HEDYSARI-PANICULATI 338 AZ 10(4):37 on Desmodium sp.

UROMYCES HETERODERMUS 797 MT 21(5):166, 1097 ID 24(3):33 on Erythronium grandiflorum; 73 WY 1(8):227 on E. parviflorum.

UROMYCES HYALINUS 280 NM 7(3):38 on Sophora sericea.

UROMYCES INTRICATUS 1497 WY 36(5):80, 1691 WY M8(2):401 on Eriogonum brevicaule; 281 WY 7(3):38, 674 CO 21(4):151 on E. campanulatum; 675 WY 21(4):151 on E. effusum; 798 MT 21(5):166 on E. flavum; 676 UT 21(4):151 on E. heracleoides; 1498 WY 36(5):80 on E. jamesii; 799 MT 21(5):166 on E. ovalifolium; 994 AZ 23(4):50 on E. racemosum.

UROMYCES JONESII 995 CO 23(4):50, 1692 WY M8(2):401 on Ranunculus alismaefolius; 282 WY 7(3):38 on R. calthaeflorus.

UROMYCES JUNCI 1098 WY 24(3):33 on Arnica chamissonis; 677 WY 21(4):151 on Helianthus nuttallii; 74 WY 1(8):227 on Juncus balticus; 166 WY 3(3):95 on J. parryi.

UROMYCES JUNCI-EFFUSI 678 WY 21(4):151 on Juncus balticus; 1693 AZ M8(2):401 on J. saximontanensis;

UROMYCES LAPPONICUS 1099 WY 24(3):33 on Astragalus alpinus; 596 WY 18(2):81 on A. campestris; 283 WY 7(3):38 on Oxytropis gracilis; 996 CO 23(4):50 on O. sericea.

UROMYCES LUPINI 597 CO 18(2):81 on Lupinus sp.; 1499 WY 36(5):80 on L. plattensis.

UROMYCES LYCOCTONI 598 WY 18(2):82 on Aconitum columbianum.

UROMYCES MEXICANUS 1695 AZ M8(2):401 on Desmodium procumbens; 1694 AZ M8(2):401 on D. rosei.

UROMYCES MINOR 339, 340 WY 10(4):37, 349 WY 10(4):37 on Trifolium anemophilum; 1296 CO 36(3):49, 1297 WY 36(3):49 on T. dasyphyllum; 1100 WY 24(3):33, 1298 UT 36(3):49 on T. longipes; 284 WY 7(3):38, 285 WY 7(3):38, 1696 CO M8(2):401 on T. parryi.

UROMYCES PECKIANUS 341 WY 10(4):37 on Plantago lanceolata.

UROMYCES PHASEOLI 1299 WY 36(3):49 on Phaseolus sp.

UROMYCES PLUMBARIUS 75 ID 1(8):227 on Pachylophus marginatus.

UROMYCES PROEMINENS 343 NM 10(4):38 on Euphorbia marginata; 342 WY 10(4):37 on E. serphyllifolia.

UROMYCES PSORALEAE 997 AZ 23(4):50, 1697 CO M8(2):401, 1698 WY M8(2):401 on Psoralea lanceolata; 76 WY 1(8):228 on P. tenuiflora.

UROMYCES PUNCTATUS 1699 AZ M8(2):401 on Astragalus lentiginosus; 77 WY 1(8):228 on Oxytropis saximontanus.

UROMYCES RICKERIANUS 78 ID 1(8):228 on Polygonum alpinum; 998 CO 23(4):50 on Rumex pauciflorus.

UROMYCES RUDBECKIAE 167 WY 3(3):95, 599 NM 18(2):82 on Rudbeckia laciniata.

UROMYCES SUKSDORFII 999 AZ 23(4):50 on Silene scouleri.

UROMYCES TRANZSCHELII 169 AZ 3(3):95 on Euphorbia lucida; 168 WY 3(3):95 on E. robusta.

UROMYCES UNITUS 800 MT 21(5):167 on Lewisia columbiana.

UROMYCES VICIAE-FABAE 1700 WY M8(2):401 on Lathyrus leucanthus.

UROMYCES ZYGADENI 344 WY 10(4):38 on Zygadenus gramineus.

UROPHLYCTIS PLURIANNULATUS 102 WY 3(3):89 on Ligusticum simulans.

UROPYXIS AMORPHAE 1000 AZ 23(4):51 on Amorpha californica; 286 AZ 7(3):38 on A. fragrans; 79 WY 1(8):228, 600 AZ 18(2):82 on A. fruticosa; 345 NM 10(4):38 on Parryella filifolia.

UROPYXIS DALEAE 1500 AZ 36(5):80 on Eysenhardtia polystachya.

UROPYXIS SANGUINEA 80 WY 1(8):228 on Berberis aquifolium.

USTILAGO BROMIVORA 443 WY 15(1):10 on Bromus marginatus; 32 WY 1(8):223 on B. polyanthus; 445 NV 15(1):10 on B. rubens; 128 WY 3(3):91, 444 CO 15(1):10 on B. tectorum.

USTILAGO BULLATA 624 WY 21(4):145 on Bromus carinatus; 1140 WY 24(4):40 on B. marginatus; 1351 UT 36(4):58 on B. polyanthus; 1546 AZ M8(2):389 on B. rubens; 1350 AZ 36(4):58 on B. tectorum.

USTILAGO CRUS-GALLI 129 WY 3(3):91 on Echinochloa crus-galli.

USTILAGO HYPODYTES 1352 AZ 36(4):58 on Oryzopsis hymenoides; 312 MT 10(4):34, 1547 WY M8(2):389 on Stipa comata.

USTILAGO LEVIS 33 WY 1(8):223 on Avena sativa.

USTILAGO LORENTZIANA 214 WY 7(3):30 on Hordeum jubatum.

USTILAGO NEGLECTA 1548 AZ M8(2):389 on Bouteloua aristidoides.

USTILAGO RESIDUA 1141 WY 24(4):40 on Danthonia unispicata.

USTILAGO STRIAEFORMIS 1142 WY 24(4):41 on Phleum pratense.

USTILAGO VILFAE 1353 NM 36(4):58 on Hilaria jamesii.

USTILAGO VINOSA 446 WY 15(1):10 on Oxyria digyna.

USTILAGO VIOLACEA 130 WY 3(3):92 on Lychnis drummondii.

VALSA NIVEA 1533 CO M8(2):388 on Populus tremuloides.

HOST INDEX

- ABIES CONCOLOR
  - Lophodermium decorum
- ABIES GRANDIS
  - Uredinopsis pteridis
- ABIES LASIOCARPA
  - Adelopus balsamicola
  - Coniophora corrugis
  - Dasyscypha arida
  - Herpotrichia nigra
  - Lachnellula chrysophthalma
  - Melampsora abieti-capraearum
  - Melampsorella caryophyllacearum
  - Melampsorella cerastii
  - Peridermium holwayi
  - Pucciniastrum epilobii
  - Pucciniastrum goeppertianum
  - Uredinopsis struthiopteridis
- ABUTILON CALIFORNICUM
  - Puccinia heterospora
- ACACIA GREGGII
  - Ravenelia versatilis
- ACER GLABRUM
  - Cylindrosporium consociatum
  - Discella pilosula
  - Nectria cinnabarina
  - Phyllosticta minutissima
  - Teichospora negundinis
- ACER GRANDIDENTATUM
  - Cylindrosporium consociatum
  - Phyllosticta minutissima
  - Rhytisma punctatum
- ACER NEGUNDO
  - Nectria cinnabarina
  - Phleospora aceris
  - Phleospora pseudoplatani
  - Phyllactinia corylea
  - Phyllosticta platanoidis
- ACHILLEA MILLEFOLIUM
  - Puccinia millefolii
- ACONITUM COLUMBIANUM
  - Plasmopara pygmaea
  - Uromyces lycoctoni

- ACTAEA ARGUTA
  - Ramularia actaeae
- ADOXA MOSCHATELLINA
  - Puccinia adoxae
  - Ramularia adoxae
- AGASTACHE URTICIFOLIA
  - Ramularia lophanthi
- AGOSERIS GLAUCA
  - Ovularia compacta
  - Puccinia hieracii
  - Puccinia dioicae
  - Puccinia extensicola
  - Puccinia suksdorfii
  - Sphaerotheca humuli
- AGOSERIS PARVIFLORA
  - Puccinia hieracii
- AGROPYRON ALBICANS
  - Puccinia recondita
- AGROPYRON ARIZONICUM
  - Puccinia recondita
- AGROPYRON DASYSTACHYUM
  - Claviceps purpurea
  - Erysiphe graminis
  - Puccinia recondita
- AGROPYRON DESERTORUM
  - Claviceps purpurea
- AGROPYRON GRIFFITHSII
  - Puccinia recondita
- AGROPYRON INERME
  - Ascochyta utahensis
  - Puccinia recondita
  - Selenophoma donacis
- AGROPYRON PAUCIFLORUM
  - Claviceps purpurea
- AGROPYRON PSEUDOREPENS
  - Puccinia recondita
- AGROPYRON REPENS
  - Erysiphe graminis
- AGROPYRON RIPARIUM
  - Erysiphe graminis
- AGROPYRON SMITHII
  - Claviceps purpurea
  - Puccinia graminis
  - Puccinia montanensis
- AGROPYRON SPICATUM
  - Puccinia montanensis
  - Puccinia pattersoniana
  - Puccinia recondita
  - Septoria agropyri
- AGROPYRON SUBSECUNDUM
  - Puccinia graminis
  - Puccinia rubigo-vera
- AGROPYRON TENERUM
  - Puccinia poculiforme
- AGROPYRON TRACHYCAULUM
  - Erysiphe graminis
  - Puccinia coronata
  - Puccinia graminis
  - Puccinia montanensis
  - Puccinia recondita
  - Puccinia rubigo-vera
- AGROSTIS ALBA
  - Puccinia coronata
- AGROSTIS SCABRA
  - Puccinia conspicua
- ALISMA PLANTAGO-AQUATICA
  - Doassansia alismatis
- ALLIUM BRANDEGEI
  - Uromyces aemulus
- ALLIUM BREVISTYLUM
  - Uromyces aemulus
- ALLIUM CERNUUM
  - Puccinia blasdalei
  - Puccinia granulispora
- ALLIUM MACROPETALUM
  - Puccinia blasdalei
- ALLIUM RUBRUM
  - Puccinia mutabilis
- ALLOPHYLLUM GILIOIDES
  - Sphaerotheca humuli
- ALNUS OBLONGIFOLIA
  - Phleospora dearnessii
  - Phyllosticta carpini
- ALNUS TENUIFOLIA
  - Phyllactinia corylea
  - Stereum hirsutum
- ALTHAEA ROSEA
  - Endophyllum tuberculatum
  - Puccinia malvacearum
  - Puccinia sherardiana
- AMARANTHUS GRAECIZANS
  - Albugo bliti
- AMARANTHUS RETROFLEXUS
  - Albugo bliti
- AMBROSIA CONFERTIFOLIA
  - Albugo tragopogonis
  - Oidium ambrosiae
  - Puccinia franseriae
  - Puccinia xanthii
- AMBROSIA DELTOIDEA
  - Puccinia franseriae
- AMBROSIA PSILOSTACHYA
  - Puccinia xanthii
- AMBROSIA TRIFIDA
  - Erysiphe cichoracearum
- AMELANCHIER ALNIFOLIA
  - Apiosporina collinsii
  - Dimerosporium collinsii
  - Gymnosporangium clavariaeforme
  - Gymnosporangium inconspicuum

Gymnosporangium juvenescens
Gymnosporangium nelsonii
Gymnosporangium nidus-avis
AMELANCHIER BAKERI
Gymnosporangium inconspicuum
Gymnosporangium nelsonii
AMELANCHIER OREOPHILA
Fabraea maculata
Gymnosporangium nelsonii
Phyllactinia corylea
AMELANCHIER PUMILA
Gymnosporangium nelsonii
AMELANCHIER UTAHENSIS
Gymnosporangium inconspicuum
Gymnosporangium nelsonii
AMORPHA CALIFORNICA
Uropyxis amorphae
AMORPHA FRAGRANS
Uropyxis amorphae
AMORPHA FRUTICOSA
Uropyxis amorphae
AMSINCKIA INTERMEDIA
Erysiphe horridula
Peronospora echinospermi
ANAPHALIS MARGARETACEA
Uromyces amoenus
ANDROPOGON HALLII
Puccinia andropogonis
ANDROPOGON SCOPARIUS
Puccinia andropogonis
ANEMONE CYLINDRICA
Puccinia recondita
ANEMONE GLOBOSA
Puccinia gigantispora
ANEMONE MULTIFIDA
Puccinia gigantispora
ANEMONE TUBEROSA
Tranzschelia cohaesa
ANEMONE ZEPHYRA
Puccinia retecta
ANGELICA AMPLA
Fusicladium depressum
Phyllosticta angelicae
ANGELICA ARGUTA
Puccinia ellisii
Ramularia angelicae
ANGELICA PINNATA
Passalora depressa
Physoderma pluriannulatum
Puccinia ligustici
ANISACANTHUS THURBERI
Puccinia anisacanthi
ANTENNARIA PULCHERRIMA
Phyllosticta ragnhildae
APIUM GRAVEOLENS
Septoria apii
AQUILEGIA COERULEA
Erysiphe polygoni
Puccinia recondita
Puccinia rubigo-vera
AQUILEGIA FORMOSA
Puccinia recondita
ARABIS SP.
Puccinia monoica
ARABIS DRUMMONDII
Peronospora parasitica
Puccinia monoica
Puccinia thlaspeos
ARABIS EXILIS
Septoria arabidis
ARABIS HOLBOELLII
Peronospora parasitica
Puccinia thlaspeos
ARABIS LIGNIFERA
Puccinia thlaspeos
ARABIS LIGNIPES
Puccinia holboellii
Puccinia thlaspeos
ARABIS LYALLII
Puccinia thlaspeos
ARABIS MICROPHYLLA
Puccinia thlaspeos
ARALIA RACEMOSA
Nyssopsora clavellosa
ARCTIUM MINUS
Puccinia calcitrapae
ARCTOSTAPHYLOS UVA-URSI
Chrysomyxa arctostaphyli
Exobasidium uvae-ursi
Exobasidium vaccinii
ARENARIA SAJANENSIS
Pyrenophora phaeospora
ARGEMONE POLYANTHEMOS
Peronospora arborescens
ARISTIDA ORCUTTIANA
Sorosporium consanguineum
ARNICA CHAMISSONIS
Entyloma arnicale
Entyloma calendulae
Puccinia arnicalis
Uromyces junci
ARNICA CORDIFOLIA
Entyloma arnicale
Entyloma calendulae
Phyllosticta arnicae
Puccinia arnicalis
ARNICA FOLIOSA
Sphaerotheca humuli
ARNICA MOLLIS

  - Entyloma calendulae
  - Puccinia arnicalis
- ARNICA SUBPLUMOSA
  - Entyloma arnicale
- ARTEMISIA AROMATICA
  - Puccinia absinthii
- ARTEMISIA CANA
  - Puccinia absinthii
  - Puccinia tanaceti
- ARTEMISIA CARRUTHII
  - Puccinia dioicae
- ARTEMISIA DRACUNCULOIDES
  - Puccinia absinthii
  - Puccinia atrofusca
  - Puccinia millifolii
  - Puccinia tanaceti
- ARTEMISIA DRACUNCULUS
  - Puccinia tanaceti
- ARTEMISIA GNAPHALODES
  - Puccinia millefolii
- ARTEMISIA LUDOVICIANA
  - Puccinia absinthii
  - Puccinia conferta
  - Puccinia tanaceti
- ARTEMISIA TRIDENTATA
  - Puccinia absinthii
  - Puccinia tanaceti
  - Syncarpella tumefaciens
- ARTEMISIA TRIPARTITA
  - Puccinia absinthii
- ASCLEPIAS SPECIOSA
  - Cercospora clavata
- ASTER SP.
  - Puccinia extensicola
- ASTER ADSCENDENS
  - Erysiphe cichoracearum
- ASTER ADSURGENS
  - Erysiphe cichoracearum
- ASTER CHILENSIS
  - Basidiophora entospora
- ASTER CONSPICUUS
  - Coleosporium asterum
  - Puccinia asteris
- ASTER ENGELMANNII
  - Ovularia asteris
  - Puccinia asteris
- ASTER FALCATUS
  - Puccinia asteris
- ASTER FLUVIATILIS
  - Erysiphe cichoracearum
- ASTER FOLIACEOUS
  - Entyloma compositarum
  - Erysiphe cichoracearum
  - Puccinia asteris
  - Puccinia dioicae
  - Puccinia extensicola
  - Ramularia asteris
- ASTER FREMONTII
  - Ramularia asteris
- ASTER FRONDEUS
  - Puccinia extensicola
- ASTER GLAUCUS
  - Puccinia asteris
- ASTER INTEGRIFOLIUS
  - Erysiphe cichoracearum
- ASTER LINDLEYANUS
  - Coleosporium solidaginis
- ASTRAGALUS ALPINUS
  - Erysiphe polygoni
  - Peronospora trifoliorum
  - Sphaerotheca humuli
  - Uromyces carneus
  - Uromyces lapponicus
- ASTRAGALUS AGRESTIS
  - Polystigma astragali
- ASTRAGALUS BISULCATUS
  - Physalospora astragali
- ASTRAGALUS CAMPESTRIS
  - Uromyces lapponicus
- ASTRAGALUS CANADENSIS
  - Erysiphe polygoni
- ASTRAGALUS DECUMBENS
  - Erysiphe polygoni
- ASTRAGALUS LENTIGINOSUS
  - Uromyces punctatus
- ASTRAGALUS NITIDUS
  - Septoria astragalicola
- AVENA FATUA
  - Puccinia poculiforme
- AVENA SATIVA
  - Ustilago levis

- BACCHARIS GLUTINOSA
  - Puccinia baccharidis
- BACCHARIS SAROTHROIDES
  - Puccinia evadens
- BAILEYA MULTIRADIATA
  - Puccinia grindeliae
- BALSAMORHIZA SAGITTATA
  - Cylindrosporium balsamorhizae
  - Phleospora balsamorhizae
  - Puccinia balsamorhizae
- BERBERIS AQUIFOLIUM
  - Cumminsiella sanguinea
  - Uropyxis sanguinea
- BERBERIS REPENS
  - Cumminsiella mirabilissima
  - Puccinia koeleriae
  - Puccinia montanensis
  - Puccinia pygmaea

BETA VULGARIS
  Cercospora beticola
BETULA OCCIDENTALIS
  Cylindrosporium utahense
  Gloeosporium betulicola
BISTORTA BISTORTOIDES
  Puccinia bistortae
BOERHAAVIA SP.
  Albugo platensis
BOGENHARDIA CRISPA
  Puccinia heterospora
BOUTELOUA ARISTIDOIDES
  Puccinia cacabata
  Ustilago neglecta
BOUTELOUA BARBATA
  Puccinia cacabata
BOUTELOUA CURTIPENDULA
  Puccinia vexans
  Scaphidium boutelouae
BOUTELOUA ROTHROCKII
  Puccinia cacabata
BRASSICA RAPA
  Alternaria herculea
BRAYULINEA DENSA
  Puccinia guillemineae
BRICKELLIA AMPLEXICAULIS
  Puccinia kuhniae
BRICKELLIA CALIFORNICA
  Coleosporium eupatorii
BRICKELLIA GRANDIFLORA
  Puccinia liatridis
  Puccinia subdecora
BRICKELLIA LEMMONII
  Puccinia kuhniae
BROMUS ANOMALUS
  Passalora graminis
  Phyllachora graminis
  Puccinia coronata
  Puccinia recondita
BROMUS CARINATUS
  Puccinia rubigo-vera
  Ustilago bullata
BROMUS CILIATUS
  Puccinia coronata
  Puccinia recondita
  Puccinia rubigo-vera
BROMUS FRONDOSUS
  Puccinia recondita
BROMUS MARGINATUS
  Erysiphe graminis
  Passalora graminis
  Phyllosticta sp.
  Puccinia recondita
  Ustilago bromivora
  Ustilago bullata
BROMUS POLYANTHUS
  Puccinia recondita
  Ustilago bromivora
  Ustilago bullata
BROMUS PORTERI
  Puccinia coronata
BROMUS RUBENS
  Ustilago bromivora
  Ustilago bullata
BROMUS TECTORUM
  Ustilago bromivora
  Ustilago bullata
CALAMAGROSTIS SP.
  Puccinia coronata
  Septogloeum oxysporum
CALAMAGROSTIS CANADENSIS
  Hendersonia calamovilfae
  Puccinia coronata
  Septogloeum oxysporum
  Stagonospora follicola
CALAMAGROSTIS INEXPANSA
  Puccinia coronata
CALAMAGROSTIS RUBESCENS
  Puccinia coronata
CALTHA LEPTOSEPALA
  Puccinia treleasiana
CALAMOVILFA LONGIFOLIA
  Puccinia amphigena
  Puccinia sporoboli
CALLIANDRA RETICULATA
  Ravenelia reticulatae
CALOCHORTUS APICULATUS
  Puccinia calochorti
CALOCHORTUS GUNNISONII
  Puccinia calochorti
CAMISSONIA CALIFORNICA
  Puccinia oenotherae
CAMISSONIA CHAMAENERIOIDES
  Peronospora arthuri
CAPSELLA BURSA-PASTORIS
  Albugo candida
CARAGANA ARBORESCENS
  Phleospora caraganae
CARDAMINE CORDIFOLIA
  Puccinia cruciferarum
CAREX SP.
  Cintractia caricis
  Puccinia caricina
  Puccinia extensicola
CAREX AQUATILIS
  Puccinia caricina
  Puccinia caricis
  Schizonella melanogramma
  Sclerotinia caricis-ampullaceae
  Septoria baudysiana
CAREX DOUGLASII
  Puccinia atrofusca

- CAREX EASTWOODII
  - Puccinia dioicae
- CAREX ELEOCHARIS
  - Puccinia atrofusca
- CAREX FESTIVELLA
  - Cintractia caricis
  - Puccinia extensicola
- CAREX FILIFOLIA
  - Cintractia caricis
  - Puccinia atrofusca
  - Puccinia dioicae
- CAREX GEYERI
  - Puccinia atrofusca
  - Puccinia extensicola
- CAREX GRAVIDA
  - Puccinia extensicola
- CAREX HEPBURNII
  - Puccinia caricina
- CAREX HOODII
  - Puccinia atrofusca
  - Puccinia dioicae
- CAREX NEBRASKENSIS
  - Puccinia caricina
  - Puccinia urticata
- CAREX NIGRICANS
  - Schizonella melanogramma
- CAREX PETASATA
  - Puccinia dioicae
- CAREX PLATYLEPIS
  - Phleospora lunelliana
- CAREX PRAEGRACILIS
  - Cintractia caricis
  - Puccinia dioicae
- CAREX PSEUDOSCIRPOIDEA
  - Schizonella melanogramma
- CAREX REYNOLDSII
  - Cintractia caricis
- CAREX ROSSII
  - Puccinia atrofusca
- CAREX ROSTRATA
  - Cintractia subinclusa
  - Puccinia caricina
  - Puccinia caricis
  - Puccinia urticata
- CAREX RUSBYI
  - Puccinia dioicae
- CAREX SENTA
  - Puccinia caricina
- CAREX SIMULATA
  - Arthrocoidea eleocharidis
- CAREX VALLICOLA
  - Cintractia carpophila
- CAREX VARIABILIS
  - Puccinia grossulariae
- CAREX VERNACULA
  - Puccinia dioicae
- CAREX VESICARIA
  - Septoria baudysiana
- CARTHAMUS TINCTORIUS
  - Puccinia carthami
- CASSIA COVESII
  - Ravenelia cassiae-covesii
- CASTILLEJA LINARIAEFOLIA
  - Cronartium coleosporioides
- CASTILLEJA MINIATA
  - Cronartium coleosporioides
  - Ramularia castillejae
  - Sphaerotheca humuli
- CASTILLEJA PATRIOTICA
  - Cronartium coleosporioides
- CATABROSA AQUATICA
  - Puccinia poae-nemoralis
- CERASTIUM ARVENSE
  - Didymobotryopsis cerastii
  - Heterosporium echinulatum
  - Melampsorella cerastii
  - Septoria commersoniana
- CHENOPODIUM ALBUM
  - Peronospora effusa
  - Peronospora farinosa
- CHENOPODIUM CAPITATUM
  - Albugo occidentalis
- CHIMAPHILA UMBELLATA
  - Pucciniastrum pyrolae
- CHRYSOPSIS VILLOSA
  - Puccinia grindeliae
  - Puccinia stipae
- CHRYSOTHAMNUS NAUSEOSUS
  - Puccinia grindeliae
- CHRYSOTHAMNUS PARRYI
  - Marssonina chrysothamni
- CHRYSOTHAMNUS PUMILUS
  - Erysiphe cichoracearum
- CHRYSOTHAMNUS VISCIDIFLORUS
  - Puccinia grindeliae
  - Puccinia stipae
- CICUTA DOUGLASII
  - Puccinia cicutae
- CICUTA OCCIDENTALIS
  - Puccinia cicutae
  - Septoria sii
- CIRSIUM SP.
  - Puccinia laschii
- CIRSIUM AMERICANUM
  - Puccinia cirsii
- CIRSIUM ARIZONICUM
  - Puccinia cirsii
- CIRSIUM ARVENSE
  - Puccinia punctiformis
- CIRSIUM CANESCENS
  - Puccinia cirsii
- CIRSIUM CENTAUREAE

Puccinia calcitrapae
CIRSIUM EDULE
  Puccinia cirsii
CIRSIUM ENGELMANNII
  Puccinia cirsii
CIRSIUM FOLIOSUM
  Puccinia cirsii
CIRSIUM NIDULUM
  Puccinia cirsii
CIRSIUM SCARIOSUM
  Puccinia cnici
CIRSIUM UNDULATUM
  Puccinia calcitrapae
  Puccinia cirsii
CLAYTONIA LANCEOLATA
  Puccinia claytoniicola
CLEMATIS COLUMBIANA
  Ramularia saximontanensis
CLEMATIS HIRSUTISSIMA
  Cercospora squalidula
  Phyllosticta tetonensis
  Puccinia recondita
CLEMATIS LIGUSTICIFOLIA
  Cercospora squalidula
  Didymaria clematidis
  Erysiphe polygoni
  Puccinia recondita
  Puccinia rubigo-vera
CLINTONIA UNIFLORA
  Puccinia mesomajalis
COLLINSIA PARVIFLORA
  Sphaerotheca humuli
  Synchytrium sp.
COLLOMIA LINEARIS
  Sphaerotheca humuli
COMANDRA PALLIDA
  Absidia spinosa
  Cronartium comandrae
  Cronartium pyriforme
CONIOSELINUM SCOPULORUM
  Puccinia ligustici
  Septoria petroselini
CONVOLVULUS ARVENSIS
  Septoria convolvuli
CORNUS CANADENSIS
  Puccinia porphyrogenita
CORNUS STOLONIFERA
  Cylindrosporium corni
  Cytospora corni
CORYDALIS AUREA
  Peronospora corydalis
COURSETIA MICROPHYLLA
  Phragmopyxis acuminata
CRACCA EDWARDSII
  Phragmopyxis deglubens
CRATAEGUS DOUGLASII
  Gymnosporangium bethelii
CRATAEGUS RIVULARIS
  Gymnosporangium bethelii
CRATAEGUS SUCCULENTA
  Gymnosporangium bethelii
CREPIS ACUMINATA
  Puccinia hieracii
CREPIS GLAUCA
  Puccinia crepidis-montanae
CREPIS RUNCINATA
  Cercoseptoria crepidis
  Puccinia crepidis-montanae
CRONARTIUM CONIGENUM
  Darluca filum
CRYPTANTHA BARBIGERA
  Erysiphe horridula
CYNOGLOSSUM OFFICINALE
  Erysiphe cichoracearum
CYPERUS RUSBYI
  Puccinia canaliculata
CYSTOPTERIS FRAGILIS
  Hyalopsora polypodii
  Uredinopsis glabra

DANTHONIA UNISPICATA
  Ustilago residua
DELPHINIUM SP.
  Puccinia recondita
DELPHINIUM BARBEYI
  Entyloma wyomingense
  Ovularia delphinii
DELPHINIUM BICOLOR
  Ovularia delphinii
DELPHINIUM BURKEI
  Ovularia delphinii
  Phyllosticta delphinii
DELPHINIUM GEYERI
  Puccinia recondita
  Puccinia rubigo-vera
DELPHINIUM OCCIDENTALE
  Entyloma winteri
  Puccinia recondita
  Ramularia sheldonii
DESCHAMPSIA CAESPITOSA
  Puccinia brachypodii
  Puccinia coronata
  Puccinia deschampsiae
DESCURAINIA PINNATA
  Albugo candida
  Peronospora parasitica
DESCURAINIA RICHARDSONII
  Peronospora parasitica
DESCURAINIA SOPHIA
  Albugo candida

DESMODIUM SP.
  Uromyces hedysari-paniculati
DESMODIUM PROCUMBENS
  Uromyces mexicanus
DESMODIUM ROSEI
  Uromyces mexicanus
DICHELOSTEMMA PULCHELLUM
  Puccinia nodosa
DIPSACUS SILVESTRIS
  Ramularia silvestris
DISTICHLIS SPICATA
  Puccinia aristidae
  Puccinia sarcobati
DISTICHLIS STRICTA
  Puccinia aristidae
DRABA CUNEIFOLIA
  Peronospora parasitica
DRABA INCERTA
  Puccinia drabae
DRABA NEMOROSA
  Albugo candida
  Peronospora parasitica

ECHINOCHLOA CRUS-GALLI
  Ustilago crus-galli
ELAEAGNUS CANADENSIS
  Puccinia coronata
ELAEAGNUS COMMUTATA
  Cercospora manitobana
ELYMUS CANADENSIS
  Puccinia recondita
ELYMUS CINEREUS
  Leptothyrium petrakii
  Puccinia recondita
ELYMUS CONDENSATUS
  Claviceps purpurea
  Puccinia rubigo-vera
ELYMUS GLAUCUS
  Claviceps purpurea
  Puccinia recondita
  Puccinia rubigo-vera
  Tilletia elymi
  Urocystis agropyri
EPILOBIUM SP.
  Pucciniastrum epilobii
EPILOBIUM ADENOCAULON
  Pucciniastrum epilobii
  Pucciniastrum pustulatum
  Ramularia punctiformis
EPILOBIUM ALPINUM
  Puccinia veratri
EPILOBIUM ANGUSTIFOLIUM
  Phyllosticta wyomingensis
  Pucciniastrum epilobii
  Ramularia cercosporoides
  Ramularia punctiformis
EPILOBIUM GLANDULOSUM
  Pucciniastrum epilobii
EPILOBIUM HORNEMANNII
  Pucciniastrum epilobii
EPILOBIUM LACTIFLORUM
  Synchytrium epilobii
EPILOBIUM MINUTUM
  Peronospora arthuri
EPILOBIUM PANICULATUM
  Puccinia pulverulenta
  Puccinia vagans
EQUISETUM LAEVIGATUM
  Titaeospora detospora
ERAGROSTIS INTERMEDIA
  Uromyces eragrostidis
ERIGERON CAESPITOSUS
  Puccinia grindeliae
ERIGERON CORYMBOSUS
  Puccinia stipae
ERIGERON EATONII
  Puccinia grindeliae
ERIGERON ELATIOR
  Puccinia asteris
ERIGERON NEMATOPHYLLUS
  Puccinia grindeliae
ERIGERON SALSUGINOSUS
  Entyloma compositarum
  Puccinia extensicola
ERIGERON SPECIOSUS
  Entyloma compositarum
  Puccinia dioicae
ERIGERON SUBTRINERVIS
  Erysiphe cichoracearum
ERIOGONUM BREVICAULE
  Uromyces intricatus
ERIOGONUM CAMPANULATUM
  Uromyces intricatus
ERIOGONUM EFFUSUM
  Uromyces intricatus
ERIOGONUM FLAVUM
  Uromyces intricatus
ERIOGONUM HERACLEOIDES
  Uromyces intricatus
ERIOGONUM JAMESII
  Uromyces intricatus
ERIOGONUM OVALIFOLIUM
  Uromyces intricatus
ERIOGONUM RACEMOSUM
  Uromyces intricatus
ERIOPHYLLUM LANATUM
  Puccinia eriophylli
ERYSIPHE CICHORACEARUM
  Cicinnobolus major
ERYTHRONIUM GRANDIFLORUM
  Uromyces heterodermus

- ERYTHRONIUM PARVIFLORUM
  - Asteroma tennerimum
  - Uromyces heterodermus
- EUPATORIUM PYCNOCEPHALUM
  - Puccinia conoclinii
- EUPATORIUM SOLIDAGINIFOLIUM
  - Puccinia inanipes
- EUPHORBIA GLYPTOSPERMA
  - Uromyces euphorbiae
- EUPHORBIA INCISA
  - Melampsora monticola
- EUPHORBIA LUCIDA
  - Uromyces tranzschelii
- EUPHORBIA MARGINATA
  - Uromyces proeminens
- EUPHORBIA ROBUSTA
  - Melampsora monticola
  - Uromyces tranzschelii
- EUPHORBIA SERPHYLLIFOLIA
  - Uromyces proeminens
- EYSENHARDTIA POLYSTACHYA
  - Uropyxis daleae
- FENDLERA RUPICOLA
  - Gymnosporangium speciosum
- FESTUCA IDAHOENSIS
  - Ophiobolus festucae
  - Puccinia crandallii
- FESTUCA OVINA
  - Puccinia crandallii
  - Puccinia poae-nemoralis
  - Uromyces dactylidis
- FESTUCA SCABRELLA
  - Puccinia crandallii
- FESTUCA THURBERI
  - Puccinia recondita
- FLOERKEA PROSPERINACOIDES
  - Peronospora floerkeae
- FOUQUIERIA SPLENDENS
  - Puccinia vexans
- FRAGARIA SP.
  - Marssonia potentillae
- FRAGARIA OVALIS
  - Kabatia fragariae
  - Mycosphaerella fragariae
- FRANSERIA DELTOIDEA
  - Puccinia franseriae
- FRANSERIA DISCOLOR
  - Plasmopara halstedii
- FRASERA SPECIOSA
  - Cercospora fraserae
- FRAXINUS MACROPETALA
  - Mycosphaerella fraxinicola
  - Phyllactinia corylea
- FRAXINUS VELUTINA
  - Mycosphaerella fraxinicola
  - Phyllactinia corylea
- GALIUM ASPERRIMUM
  - Marssonia galii
- GALIUM BOREALE
  - Pseudopeziza repanda
  - Puccinia rubefaciens
  - Sporonema punctiforme
- GALIUM TRIFLORUM
  - Puccinia punctata
- GAYOPHYTUM DIFFUSUM
  - Ramularia gayophyti
- GAYOPHYTUM NUTTALLII
  - Puccinia pulverulenta
- GAYOPHYTUM RACEMOSUM
  - Puccinia gayophyti
  - Puccinia pulverulenta
- GAYOPHYTUM RAMOSISSIMUM
  - Puccinia gayophyti
  - Puccinia pulverulenta
- GENTIANA AFFINIS
  - Puccinia gentianae
- GENTIANA BIGELOVII
  - Puccinia gentianae
- GENTIANA CALYCOSA
  - Puccinia haleniae
- GENTIANA PARRYI
  - Puccinia gentianae
- GERANIUM SP
  - Cercospora ithacensis
- GERANIUM FREMONTII
  - Puccinia leveillei
  - Sphaerotheca humuli
- GERANIUM NERVOSUM
  - Sphaerotheca humuli
- GERANIUM RICHARDSONII
  - Cercospora geranii
  - Plasmopara geranii
- GERANIUM VISCOSISSIMUM
  - Cercospora geranii
  - Cercospora ithacensis
  - Sphaerotheca humuli
- GEUM MACROPHYLLUM
  - Ramularia gei
  - Sphaerotheca humuli
- GLYCERIA STRIATA
  - Septoria avenae
- GLYCYRRHIZA LEPIDOTA
  - Uromyces glycyrrhizae
- GOSSYPIUM HIRSUTUM
  - Puccinia cacabata
- GRINDELIA SP.
  - Puccinia grindeliae
- GRINDELIA PERENNIS
  - Erysiphe cichoracearum
- GRINDELIA SQUARROSA
  - Puccinia grindeliae

- GUTIERREZIA SAROTHRAE
  - Erysiphe cichoracearum
  - Puccinia grindeliae
  - Puccinia sarothrae
  - Puccinia stipae
- HAPLOPAPPUS SPINULOSUS
  - Puccinia grindeliae
- HEDYSARUM BOREALE
  - Uromyces hedysari-obscuri
- HEDYSARUM MARGINATUM
  - Septogloeum hedysari
  - Uromyces hedysari-obscuri
- HEDYSARUM OCCIDENTALE
  - Uromyces hedysari-obscuri
- HEDYSARUM PABULARE
  - Uromyces hedysari-obscuri
- HEDYSARUM SULPHURESCENS
  - Uromyces hedysari-obscuri
- HELENIUM HOOPESII
  - Puccinia conspicua
  - Puccinia poarum
- HELIANTHELLA QUINQUENERVIS
  - Puccinia helianthellae
  - Ramularia helianthi
- HELIANTHELLA UNIFLORA
  - Puccinia helianthellae
- HELIANTHUS ANNUUS
  - Plasmopara halstedii
  - Puccinia helianthi
  - Septoria helianthi
- HELIANTHUS FASCICULARIS
  - Puccinia helianthi
- HELIANTHUS NUTTALLII
  - Plasmopara halstedii
  - Uromyces junci
- HELIOPSIS PARVIFOLIA
  - Puccinia canaliculata
- HERACLEUM LANATUM
  - Cylindrosporium heraclei
  - Cylindrosporium umbelliferarum
  - Phyllachora heraclei
  - Ramularia heraclei
- HESPEROCHLOA KINGII
  - Puccinia crandallii
- HETEROPOGON CONTORTUS
  - Puccinia versicolor
- HEUCHERA BRACTEATA
  - Puccinia heucherae
- HIERACIUM ALBERTINUM
  - Puccinia hieracii
- HIERACIUM ALBIFLORUM
  - Puccinia fraseri
  - Puccinia hieracii
- HIERACIUM CUSICKII
  - Puccinia dioicae
- HILARIA JAMESII
  - Ustilago vilfae
- HOLCUS LANATUS
  - Puccinia coronata
- HORDEUM BRACHYANTHERUM
  - Passalora graminis
- HORDEUM JUBATUM
  - Scolecotrichum graminis
  - Ustilago lorentziana
- HYDROPHYLLUM CAPITATUM
  - Cylindrosporium hydrophylli
  - Didymaria hydrophylli
  - Puccinia recondita
- HYDROPHYLLUM FENDLERI
  - Puccinia apocrypta
  - Puccinia hydrophylli
  - Puccinia recondita
- HYMENOCLEA FASCICULATA
  - Puccinia splendens
- HYMENOCLEA MONOGYRA
  - Puccinia franseriae
  - Puccinia splendens
- HYMENOCLEA PENTALEPIS
  - Puccinia franseriae
- HYPTIS EMORYI
  - Puccinia distorta

- INDIGOFERA SPHAEROCARPA
  - Ravenelia indigoferae
- IRIS SP.
  - Heterosporium gracile
- IRIS MISSOURIENSIS
  - Puccinia iridis
- IRIS PELOGONUS
  - Puccinia iridis
- IVA AXILLARIS
  - Puccinia intermixta

- JUNCUS BALTICUS
  - Uromyces junci
  - Uromyces junci-effusi
- JUNCUS DRUMMONDII
  - Crandallia juncicola
  - Duplicaria acuminata
- JUNCUS PARRYI
  - Uromyces junci
- JUNCUS SAXIMONTANENSIS
  - Uromyces junci-effusi
- JUNIPERUS COMMUNIS
  - Gymnosporangium clavariaeforme
  - Gymnosporangium tremelloides
- JUNIPERUS DEPPEANA
  - Gymnosporangium kernianum
  - Gymnosporangium speciosum
- JUNIPERUS MONOSPERMA
  - Gymnosporangium kernianum
  - Gymnosporangium nelsonii

  - Gymnosporangium speciosum
- JUNIPERUS OSTEOSPERMA
  - Gymnosporangium inconspicuum
- JUNIPERUS SCOPULORUM
  - Caldesia sabina
  - Gymnosporangium nelsonii
  - Gymnosporangium nidus-avis

- KOELERIA CRISTATA
  - Puccinia coronata
  - Puccinia liatridis
  - Puccinia monoica
  - Puccinia pygmaea
- KUHNIA ROSMARINIFOLIA
  - Puccinia kuhniae

- LACTUCA PULCHELLA
  - Puccinia minussensis
- LACTUCA SCARIOLA
  - Erysiphe cichoracearum
- LAPPULA REDOWSKII
  - Erysiphe horridula
  - Peronospora echinospermi
- LATHYRUS ARIZONICUS
  - Uromyces fabae
- LATHYRUS DECAPHYLLUS
  - Uromyces fabae
- LATHYRUS EUCOSMUS
  - Uromyces fabae
- LATHYRUS LAETIVIRENS
  - Uromyces fabae
- LATHYRUS LANSWERTII
  - Uromyces fabae
- LATHYRUS LEUCANTHUS
  - Uromyces viciae-fabae
- LATHYRUS POLYMORPHUS
  - Uromyces fabae
- LEDUM GLANDULOSUM
  - Chrysomyxa ledi
- LEDUM GROENLANDICUM
  - Chrysomyxa ledicola
- LEPIDIUM DENSIFLORUM
  - Albugo candida
- LEPIDIUM LASIOCARPUM
  - Peronospora parasitica
- LEPIDIUM MEDIUM
  - Peronospora lepidii
  - Peronospora parasitica
- LEPIDIUM THURBERI
  - Peronospora lepidii
- LEPTOTAENIA MULTIFIDA
  - Puccinia jonesii
- LESQUERELLA GORDONII
  - Peronospora parasitica
- LESQUERELLA PURPUREA
  - Peronospora parasitica
- LEWISIA COLUMBIANA
  - Uromyces unitus
- LIGUSTICUM PORTERI
  - Cylindrosporium heraclei
  - Nyssopsora echinata
  - Peronospora echinata
- LIGUSTICUM SIMULANS
  - Cylindrosporium heraclei
  - Puccinia jonesii
  - Puccinia ligustici
  - Urophlyctis pluriannulatus
- LINNAEA BOREALIS
  - Phyllachora wittrockii
- LINUM LEWISII
  - Melampsora lini
- LOMATIUM DISSECTUM
  - Puccinia jonesii
- LOMATIUM MONTANUM
  - Puccinia musenii
- LOMATIUM NUDICAULE
  - Asperisporium peucedani
- LONICERA INVOLUCRATA
  - Herpobasidium deformans
  - Kabatia lonicerae
  - Kabatia mirabilis
  - Microsphaera lonicerae
- LONICERA UTAHENSIS
  - Leptothyrium periclymeni
  - Microsphaera alni
  - Ramularia lonicerae
- LUPINUS SP.
  - Hadrotrichum lupini
  - Phyllosticta ferax
  - Uromyces lupini
- LUPINUS ALPESTRIS
  - Hadrotrichum lupini
  - Phyllosticta ferax
- LUPINUS ARGENTEUS
  - Erysiphe polygoni
  - Hadrotrichum globiferum
  - Hadrotrichum lupini
  - Phyllosticta ferax
- LUPINUS PARVIFLORUS
  - Hadrotrichum globiferum
- LUPINUS PLATTENSIS
  - Sorosporium astragali
  - Uromyces lupini
- LUPINUS SERICEUS
  - Hadrotrichum globiferum
  - Phyllosticta ferax
- LYCHNIS DRUMMONDII
  - Ustilago violacea
- LYCIUM BERLANDIERI
  - Puccinia globosipes
- LYCIUM CALIFORNICUM
  - Puccinia globosipes

- LYCIUM EXSERTUM
  - Puccinia globosipes
- LYCIUM FREMONTII
  - Puccinia globosipes
- LYCIUM PALLIDUM
  - Puccinia tumidipes
- LYCURUS PHLEOIDES
  - Puccinia schedonnardi
- LYGODESMIA JUNCEA
  - Puccinia hieracii

- MALVA ROTUNDIFOLIA
  - Puccinia malvacearum
- MALVASTRUM COCCINEUM
  - Puccinia sherardiana
- MATRICARIA MATRICARIOIDES
  - Albugo tragopogonis
- MEDICAGO SATIVA
  - Peronospora trifoliorum
  - Pseudopeziza medicaginis
- MELILOTUS ALBA
  - Stagonospora meliloti
- MENTHA ARVENSIS
  - Erysiphe cichoracearum
  - Phyllosticta decidua
  - Puccinia angustata
  - Ramularia menthicola
- MENTHA CANADENSIS
  - Puccinia menthae
  - Ramularia menthicola
  - Septoria menthicola
- MENTHA SPICATA
  - Puccinia menthae
- MENYANTHES TRIFOLIATA
  - Physoderma menyanthis
- MENZIESIA FERRUGINEA
  - Exobasidium vaccinii
- MERTENSIA SP.
  - Erysiphe cichoracearum
- MERTENSIA CILIATA
  - Entyloma serotinum
  - Erysiphe cichoracearum
  - Puccinia hydrophylli
  - Puccinia mertensiae
- MIRABILIS LONGIFLORA
  - Aecidium mirabilis
- MITELLA PENTANDRA
  - Puccinia heucherae
- MITELLA STAUROPETALA
  - Puccinia heucherae
- MONARDA FISTULOSA
  - Puccinia menthae
- MONARDA MENTHAEFOLIA
  - Puccinia menthae
- MUHLENBERGIA ARIZONICA
  - Phleospora muhlenbergiae
- MUHLENBERGIA ASPERIFOLIA
  - Puccinia schedonnardi
  - Tilletia asperifolia
- MUHLENBERGIA EMERSLEYI
  - Phyllachora epicampis
- MUHLENBERGIA GLAUCA
  - Phyllachora vulgata
- MUHLENBERGIA LONGILIGULA
  - Phyllachora epicampis
- MUHLENBERGIA METCALFII
  - Phyllachora epicampis
- MUHLENBERGIA MONTANA
  - Puccinia schedonnardi
- MUHLENBERGIA RINGENS
  - Phyllachora epicampis
  - Uromyces epicampis

- NICOTIANA TRIGONOPHYLLA
  - Peronospora tabacina

- OENOTHERA CAESPITOSA
  - Puccinia dioicae
- OENOTHERA HETERANTHA
  - Puccinia oenotherae
- OENOTHERA NUTTALLII
  - Puccinia redfieldiae
- OENOTHERA PRIMIVERIS
  - Alternaria tenuis
  - Peronospora arthuri
- ORYZOPSIS HYMENOIDES
  - Puccinia monoica
  - Puccinia substerilis
  - Ustilago hypodytes
- ORYZOPSIS MICRANTHA
  - Puccinia micrantha
- OSMORHIZA DIVARICATA
  - Phleospora osmorhizae
- OSMORHIZA OBTUSA
  - Phleospora osmorhizae
  - Puccinia pimpinellae
- OSMORHIZA OCCIDENTALIS
  - Phleospora osmorhizae
  - Puccinia pimpinellae
- OXYPOLIS FENDLERI
  - Puccinia ligustici
- OXYRIA DIGYNA
  - Ustilago vinosa
- OXYTROPIS GRACILIS
  - Uromyces lapponicus
- OXYTROPIS SAXIMONTANUS
  - Uromyces punctatus
- OXYTROPIS SERICEA
  - Uromyces lapponicus
- PACHYLOPHUS MARGINATUS
  - Uromyces plumbarius

- PANICUM BULBOSUM
  - Puccinia atra
- PARNASSIA FIMBRIATA
  - Puccinia parnassiae
- PARRYELLA FILIFOLIA
  - Uropyxis amorphae
- PEDICULARIS BRACTEOSA
  - Apiosporella alpina
  - Puccinia clintonii
  - Sphaerotheca fuliginea
- PEDICULARIS CENTRANTHERA
  - Puccinia rufescens
- PEDICULARIS GROENLANDICA
  - Puccinia clintonii
- PEDICULARIS PAYSONIANA
  - Phyllosticta pedicularidis
  - Puccinia clintonii
  - Ramularia obducens
  - Sphaerotheca humuli
- PENSTEMON SP.
  - Puccinia palmeri
  - Ramularia nivosa
- PENSTEMON ALPINUS
  - Puccinia andropogonis
- PENSTEMON BRIDGESII
  - Puccinia pentstemonis
- PENSTEMON CONFERTUS
  - Puccinia palmeri
- PENSTEMON CONNATIFOLIUS
  - Puccinia pentstemonis
- PENSTEMON DEUSTUS
  - Puccinia pentstemonis
- PENSTEMON ELLIPTICUS
  - Puccinia palmeri
- PENSTEMON PINIFOLIUS
  - Puccinia pentstemonis
- PENSTEMON PROCERUS
  - Puccinia palmeri
- PERIDERIDIA GAIRDNERI
  - Passalora depressa
- PETALOSTEMON PURPUREUS
  - Puccinia andropogonis
- PHACELIA HETEROPHYLLA
  - Puccinia recondita
- PHACELIA LEUCOPHYLLA
  - Puccinia rubigo-vera
  - Ramularia phaceliae
- PHALARIS ARUNDINACEA
  - Puccinia coronata
- PHASEOLUS SP.
  - Uromyces phaseoli
- PHILADELPHUS RUGOSUS
  - Gymnosporangium tremelloides
- PHLEUM PRATENSE
  - Puccinia brachypodii
  - Puccinia graminis
  - Puccinia poae-nemoralis
  - Ustilago striaeformis
- PHLOX GLABRATA
  - Puccinia douglasii
- PHLOX LONGIFOLIA
  - Puccinia plumbaria
  - Sphaerotheca humuli
- PHLOX MULTIFLORA
  - Puccinia plumbaria
- PHRAGMITES COMMUNIS
  - Puccinia rubella
- PICEA ENGELMANNII
  - Chrysomyxa arctostaphyli
  - Fomes nigrolimitatus
  - Fomes pini
  - Fomes pinicola
  - Herpotrichia nigra
  - Lenzites saepiaria
  - Melampsorella caryophyllacearum
  - Melampsorella cerastii
  - Neopeckia coulteri
  - Polyporus alboluteus
  - Polyporus leucospongia
  - Stereum rugisporum
  - Trametes isabellina
- PICEA PUNGENS
  - Melampsorella caryophyllacearum
- PINUS CHIHUAHUANA
  - Cronartium conigenum
- PINUS CONTORTA
  - Coniophora corrugis
  - Cronartium coleosporioides
  - Cronartium comandrae
  - Dasycypha arida
  - Dasycypha fuscosanguinea
  - Dasycypha oblongispora
  - Discina ancilis
  - Lophodermella montivaga
  - Neopeckia coulteri
  - Polyporus dichrous
- PINUS EDULIS
  - Coleosporium crowellii
  - Coleosporium jonesii
- PINUS FLEXILIS
  - Bifusella linearis
  - Bifusella saccata
  - Coniophora corrugis
  - Hypoderma saccatum
  - Lophodermella arcuata
- PINUS MONOPHYLLA
  - Bifusella pini
- PINUS PONDEROSA
  - Davisomycella ponderosae
  - Hemiphacidium planum
  - Lophodermella cerina
  - Peridermium filamentosum

PIPTOCHAETIUM FIMBRIATUM
  Puccinia neocoronata
PLANTAGO ERIOPODA
  Puccinia subnitens
  Sphaerotheca humuli
PLANTAGO LANCEOLATA
  Uromyces peckianus
PLANTAGO MAJOR
  Erysiphe cichoracearum
POA ALPINA
  Puccinia brachypodii
POA AMPLA
  Erysiphe graminis
POA CANBYI
  Erysiphe graminis
  Uromyces dactylidis
POA FENDLERIANA
  Puccinia crandallii
POA INTERIOR
  Puccinia brachypodii
  Puccinia poae-nemoralis
POA LEPTOCOMA
  Puccinia brachypodii
  Puccinia poae-nemoralis
POA LONGILIGULA
  Puccinia crandallii
POA PALUSTRIS
  Puccinia poae-nemoralis
  Puccinia poae-sudeticae
POA PRATENSIS
  Erysiphe graminis
  Puccinia poae-nemoralis
POA REFLEXA
  Puccinia brachypodii
  Puccinia poae-nemoralis
POA SECUNDA
  Puccinia monoica
POLEMONIUM OCCIDENTALE
  Septoria polemonii
POLYGONUM SP.
  Puccinia polygoni-amphibii
POLYGONUM ALPINUM
  Uromyces rickerianus
POLYGONUM AVICULARE
  Erysiphe polygoni
POLYGONUM BISTORTOIDES
  Ovularia bistortae
  Puccinia bistortae
POLYGONUM BUXAFORME
  Erysiphe polygoni
POLYGONUM EXSERTUM
  Erysiphe polygoni
POLYGONUM PERSICARIA
  Septoria polygonorum
POLYGONUM VIVIPARUM
  Puccinia bistortae
  Sphacelotheca inflorescentiae
POPULUS SP.
  Cytospora chrysosperma
  Marssonina populi
  Melampsora albertensis
POPULUS ANGUSTIFOLIA
  Amphisphaeria separans
  Cylindrosporium oculatum
  Cylindrosporium saximontanense
  Marssonina populi
  Melampsora albertensis
  Melampsora occidentalis
  Phyllactinia corylea
  Phyllosticta brunnea
POPULUS BALSAMIFERA
  Uncinula salicis
POPULUS FREMONTII
  Phyllosticta brunnea
POPULUS TACAMAHACA
  Septoria populi
POPULUS TREMULOIDES
  Armillaria mellea
  Ciborinia confundens
  Cytospora chrysosperma
  Fomes igniarius
  Ganoderma applanatum
  Hypoxylon pruinatum
  Marssonina brunnea
  Melampsora albertensis
  Melampsora medusae
  Polyporus adustus
  Sclerotium bifrons
  Septogloeum rhopaloideum
  Stereum rufum
  Trametes hispida
  Uncinula salicis
  Valsa nivea
POTENTILLA ARGUTA
  Ramularia arvensis
POTENTILLA CONCINNA
  Phragmidium ivesiae
POTENTILLA DIVERSIFOLIA
  Phragmidium ivesiae
POTENTILLA FISSA
  Marssonina potentillae
POTENTILLA FLABELLIFORMIS
  Phragmidium ivesiae
POTENTILLA FRUTICOSA
  Phragmidium andersonii
POTENTILLA GRACILIS
  Cylindrosporium triflori
  Peronospora potentillae
  Phragmidium ivesiae
  Ramularia arvensis
  Septoria purpurascens

- POTENTILLA NORVEGICA
  - Ramularia arvensis
- POTENTILLA NUTTALLII
  - Peronospora potentillae
  - Phragmidium ivesiae
- POTENTILLA PENNSYLVANICA
  - Phragmidium potentillae
- POTENTILLA PULCHERRIMA
  - Peronospora potentillae
  - Phragmidium ivesiae
  - Ramularia arvensis
- POTENTILLA STRIGOSA
  - Phragmidium potentillae
- PRUNUS SP.
  - Phyllosticta virginiana
- PRUNUS MELANOCARPA
  - Podosphaera oxyacanthae
- PRUNUS VIRENS
  - Phyllosticta virginiana
  - Tranzschelia pruni-spinosae
- PRUNUS VIRGINIANA
  - Dibotryon morbosum
  - Taphrina confusa
- PSEUDOCYMOPTERUS MONTANUS
  - Phleospora osmorhizae
  - Puccinia pseudocymopteri
- PSEUDOCYMOPTERUS SYLVATICUS
  - Puccinia pseudocymopteri
- PSEUDOTSUGA MENZIESII
  - Melampsora medusae
  - Rhabdogloeum pseudotsugae
- PSEUDOTSUGA TAXIFOLIA
  - Melampsora occidentalis
  - Rhabdocline pseudotsugae
- PSILOSTROPHE COOPERI
  - Puccinia grindeliae
- PSORALEA LANCEOLATA
  - Uromyces psoraleae
- PSORALEA TENUIFLORA
  - Uromyces psoraleae
- PTERIDIUM AQUILINUM
  - Melasmia imitans
  - Uredinopsis pteridis
- PTILORIA RUNCINATA
  - Puccinia harknessii
- PUCCINIA ARISTIDAE
  - Tuberculina persicina
- PUCCINIA SUBSTERILIS
  - Darluca filum
- PYROLA ASARIFOLIA
  - Chrysomyxa pirolata
- PYROLA CHLORANTHA
  - Chrysomyxa pirolata
- PYROLA SECUNDA
  - Pucciniastrum pyrolae
- PYROLA VIRENS
  - Pucciniastrum pyrolae

- QUERCUS ARIZONICA
  - Typhulochaeta japonica
- QUERCUS EMORYI
  - Cronartium conigenum
- QUERCUS GAMBELII
  - Diatrype albopruinosa
  - Exidia glandulosa
  - Microsphaera alni
  - Taphrina caerulescens
- QUERCUS GRISEA
  - Cronartium conigenum
- QUERCUS HYPOLEUCOIDES
  - Cronartium conigenum

- RANUNCULUS ACRIFORMIS
  - Peronospora ficariae
- RANUNCULUS ALISMAEFOLIUS
  - Uromyces jonesii
- RANUNCULUS CALTHAEFLORUS
  - Uromyces jonesii
- RANUNCULUS CYMBALARIA
  - Puccinia rubigo-vera
- RANUNCULUS MACOUNII
  - Ovularia decipiens
- RAPHANUS SATIVA
  - Albugo candida
- RATIBIDA TAGETES
  - Anthostomella ratibidea
- REDFIELDIA FLEXUOSA
  - Puccinia redfieldiae
- RHAMNUS ALNIFOLIA
  - Puccinia coronata
- RHAMNUS BETULAEFOLIA
  - Phyllosticta cinerea
- RHINANTHUS KYROLLAE
  - Cronartium coleosporioides
- RHUS RADICANS
  - Pileolaria brevipes
- RHUS TRILOBATA
  - Pileolaria patzcuarensis
- RIBES AUREUM
  - Cronartium occidentale
- RIBES CEREUM
  - Coleosporium jonesii
  - Pseudopeziza ribis
- RIBES INEBRIANS
  - Coleosporium jonesii
- RIBES INERME
  - Coleosporium jonesii
  - Gloeosporium ribis
  - Melampsora epitea
  - Melampsora ribesii-purpureae
  - Pseudopeziza ribis
  - Puccinia caricina

  - Septoria siberica
- RIBES LACUSTRE
  - Melampsora ribesii-purpureae
  - Puccinia parkerae
- RIBES LEPTANTHUM
  - Coleosporium jonesii
- RIBES PINETORUM
  - Coleosporium jonesii
- RIBES SAXOSUM
  - Coleosporium jonesii
  - Gloeosporium ribis
  - Puccinia grossulariae
  - Septoria ribis
- RIBES SETOSUM
  - Puccinia caricina
- RIBES VELUTINA
  - Coleosporium jonesii
- RIBES VISCOSISSIMUM
  - Cercoseptoria ribis
  - Cercospora septoriopsis
- ROBINIA NEOMEXICANA
  - Phyllactinia corylea
- ROSA SP.
  - Cercospora rosicola
  - Phragmidium fusiforme
  - Phragmidium montivagum
  - Phragmidium rosae-arkansanae
  - Phyllosticta rosicola
- ROSA ACICULARIS
  - Phragmidium fusiforme
  - Phragmidium montivagum
  - Phragmidium rosea-acicularis
- ROSA ENGELMANNII
  - Phragmidium fusiforme
- ROSA FENDLERI
  - Phragmidium montivagum
- ROSA FOETIDA
  - Phragmidium rosae-pimpinellifoliae
- ROSA MANCA
  - Phragmidium montivagum
- ROSA WOODSII
  - Phragmidium fusiforme
  - Phragmidium montivagum
- RUBUS SP.
  - Coleroa chaetomium
  - Phragmidium ribi-idaei
- RUBUS DELICIOSUS
  - Phragmidium peckianum
- RUBUS IDAEUS
  - Phragmidium rubi-idaei
- RUBUS LEUCODERMUS
  - Phragmidium rubi-idaei
- RUBUS NEOMEXICANUS
  - Phragmidium peckianum
- RUBUS PARVIFLORUS
  - Phragmidium occidentale
- RUBUS PUBESCENS
  - Kunkelia nitens
- RUBUS STRIGOSUS
  - Coleroa rubicola
  - Phragmidium rubi-idaei
- RUDBECKIA LACINIATA
  - Phyllactinia corylea
  - Ramularia rudbeckiae
  - Uromyces rudbeckiae
- RUDBECKIA OCCIDENTALIS
  - Ramularia rudbeckiae
- RUMEX SP.
  - Ramularia decipiens
- RUMEX CRISPUS
  - Ovularia monosporia
  - Ovularia obliqua
- RUMEX HYMENOSEPALUS
  - Ovularia monosporia
- RUMEX PAUCIFLORUS
  - Uromyces rickerianus
- RUMEX VENOSUS
  - Ramularia decipiens
  - Septoria rumicis
- SALIX SP.
  - Gloeosporium boreale
  - Lophionema apoclastospora
  - Marssonina kriegeriana
  - Melampsora abieti-capraearum
  - Melampsora confluens
  - Melampsora epitea
  - Melampsora ribesii-purpureae
  - Rhytisma salicinum
- SALIX AMYGDALOIDES
  - Melampsora americana
  - Melampsora epitea
  - Melampsora paradoxa
  - Melampsora ribesii-purpureae
  - Uncinula salicis
- SALIX ANGLORUM
  - Melampsora arctica
  - Rhytisma salicinum
- SALIX BABYLONICA
  - Cytospora chrysosperma
- SALIX BEBBIANA
  - Melampsora abieti-capraearum
  - Melampsora americana
  - Melampsora bigelowii
  - Melampsora paradoxa
  - Melampsora ribesii-purpureae
- SALIX BONPLANDIANA
  - Melampsora epitea
- SALIX DRUMMONDIANA
  - Marssonina kriegeriana
  - Melampsora epitea
  - Melampsora ribesii-purpureae

  - Rhytisma salicinum
- SALIX EXIDUA
  - Marssonia kriegeriana
  - Marssonina kriegeriana
  - Melampsora abieti-capraearum
  - Melampsora bigelowii
  - Rhytisma salicinum
- SALIX FLUVIATILIS
  - Melampsora bigelowii
  - Rhytisma salicinum
- SALIX GEYERIANA
  - Melampsora epitea
  - Melampsora paradoxa
  - Melampsora ribesii-purpureae
- SALIX GLAUCOPS
  - Gloeosporium boreale
  - Marssonina kriegeriana
- SALIX LAEVIGATA
  - Melampsora ribesii-purpureae
- SALIX LASIANDRA
  - Cylindrosporium conservans
  - Septogloeum salicis-fendlerianae
- SALIX LIGULIFOLIA
  - Melampsora ribesii-purpureae
- SALIX LUTEA
  - Melampsora paradoxa
  - Melampsora ribesii-purpureae
- SALIX MONTICOLA
  - Gloeosporium boreale
  - Marssonina kriegeriana
  - Rhytisma salicinum
  - Uncinula salicis
- SALIX MYRTILLIFOLIA
  - Melampsora paradoxa
- SALIX NELSONII
  - Melampsora bigelowii
- SALIX NUTTALLII
  - Melampsora ribesii-purpureae
- SALIX PSEUDOCORDATA
  - Melampsora paradoxa
  - Melampsora ribesii-purpureae
  - Uncinula salicis
- SALIX SCOULERIANA
  - Melampsora bigelowii
  - Melampsora epitea
  - Melampsora ribesii-purpureae
  - Rhytisma salicinum
  - Uncinula salicis
- SALIX SUBCOERULEA
  - Marssonina kriegeriana
  - Melampsora abieti-capraearum
  - Melampsora ribesii-purpureae
- SALVIA LEMMONII
  - Puccinia biporula
- SALVIA PINGUIFOLIA
  - Puccinia vertisepta
- SAMBUCUS SP.
  - Septoria sambucina
- SANGUISORBA SITCHENSIS
  - Ovularia bulbigera
- SARCOBATUS VERMICULATUS
  - Puccinia aristidae
- SAXIFRAGA ARGUTA
  - Phyllosticta saxifragarum
  - Puccinia heucherae
  - Sphaerotheca humuli
- SAXIFRAGA LYALLII
  - Puccinia heucherae
- SAXIFRAGA RHOMBOIDEA
  - Puccinia heucherae
- SCHOENOCRAMBE LINIFOLIA
  - Puccinia consimilis
  - Puccinia holboellii
  - Puccinia monoica
- SCIRPUS AMERICANUS
  - Puccinia obtecta
- SCIRPUS MICROCARPUS
  - Puccinia mcclatchieana
- SCUTELLARIA GALERICULATA
  - Septoria scutellariae
- SENECIO CRASSULUS
  - Puccinia senecionis
  - Puccinia subcircinata
- SENECIO HYDROPHILOIDES
  - Ramularia senecionis
- SENECIO INTEGERRIMUS
  - Puccinia expansa
  - Puccinia stipae
  - Ramularia senecionis
- SENECIO PERPLEXUS
  - Puccinia stipae
- SENECIO RAPIFOLIUS
  - Ramularia pruinosa
- SENECIO SERRA
  - Ramularia pruinosa
- SENECIO SPARTIOIDES
  - Sphaerotheca humuli
- SENECIO TRIANGULARIS
  - Entyloma calendulae
  - Phyllosticta garrettii
  - Ramularia pruinosa
  - Sphaerotheca humuli
- SETARIA GRISEBACHII
  - Puccinia atra
- SHEPHERDIA CANADENSIS
  - Puccinia allenii
  - Puccinia coronata
- SIDALCEA NEOMEXICANA
  - Endophyllum tuberculatum
- SILENE SCOULERI
  - Uromyces suksdorfii

- SISYMBRIUM ALTISSIMUM
  - Albugo candida
- SISYMBRIUM IRIO
  - Albugo candida
- SISYMBRIUM LINIFOLIUM
  - Albugo candida
- SITANION HYSTRIX
  - Puccinia montanensis
  - Puccinia recondita
  - Puccinia rubigo-vera
  - Scolecotrichum graminis
- SMELOWSKIA CALYCINA
  - Puccinia aberrans
- SMILACINA AMPLEXICAULIS
  - Phyllosticta smilacinae
  - Ramularia smilacinae
- SMILACINA STELLATA
  - Cylindrosporium smilacinae
  - Uromyces acuminatus
- SOLANUM TRIFLORUM
  - Entyloma physalidis
- SOLIDAGO SP.
  - Erysiphe cichoracearum
- SOLIDAGO CANADENSIS
  - Phyllosticta solidaginis
  - Ramularia serotina
- SOLIDAGO ELONGATA
  - Puccinia grindeliae
- SOLIDAGO LEPIDA
  - Ramularia serotina
- SOLIDAGO MISSOURIENSIS
  - Coleosporium asterum
  - Puccinia dioicae
  - Ramularia serotina
- SOLIDAGO MULTIRADIATA
  - Puccinia grindeliae
- SOLIDAGO NANA
  - Puccinia stipae
- SOLIDAGO PETRADORIA
  - Phyllosticta solidaginis
  - Puccinia grindeliae
- SOLIDAGO SEROTINA
  - Ramularia serotina
- SOPHIA PROCERA
  - Peronospora parasitica
- SOPHORA SERICEA
  - Uromyces hyalinus
- SORBUS SITCHENSIS
  - Gymnosporangium tremelloides
- SORBUS SCOPULINA
  - Gymnosporangium tremelloides
  - Gymnosporangium cornutum
- SORGHUM HALEPENSE
  - Sphacelotheca sorghi
- SPARTINA PECTINATA
  - Puccinia sparganioides
- SPHAERALCEA ANGUSTIFOLIA
  - Puccinia sherardiana
- SPHAERALCEA COCCINEA
  - Puccinia schedonnardi
  - Puccinia sherardiana
- SPHAERALCEA COULTERI
  - Puccinia sherardiana
- SPHAERALCEA EMORYI
  - Puccinia sherardiana
- SPHAERALCEA FENDLERI
  - Puccinia sherardiana
- SPHAERALCEA LAXA
  - Puccinia sherardiana
- SPHAERALCEA LOBATA
  - Puccinia sherardiana
- SPHAERALCEA MARGINATA
  - Puccinia sherardiana
- SPIRAEA LUCIDA
  - Cylindrosporium spiraeicolum
  - Podosphaera oxyacanthae
- SPIRAEA SPLENDENS
  - Cylindrosporium filipendulae
- STACHYS COCCINEA
  - Puccinia pallidissima
- STACHYS PALUSTRIS
  - Erysiphe galeopsidis
- STENOTUS ACAULIS
  - Puccinia grindeliae
- STEPHANOMERIA TENUIFOLIA
  - Puccinia harknessii
- STIPA COLUMBIANA
  - Darluca filum
  - Puccinia substerilis
- STIPA COMATA
  - Puccinia stipae
  - Ustilago hypodytes
- STIPA LETTERMANII
  - Puccinia substerilis
- STIPA PRINGLEI
  - Puccinia durangensis
  - Puccinia stipae
- STIPA ROBUSTA
  - Puccinia scaber
- STIPA SCRIBNERI
  - Puccinia substerilis
- STIPA VIRIDULA
  - Puccinia substerilis
- STREPTANTHUS ARIZONICUS
  - Peronospora parasitica
- SWERTIA RADIATA
  - Cercospora fraserae
- SWERTIA PERENNIS
  - Puccinia swertiae
- SYMPHORICARPOS SP.
  - Cercospora symphoricarpi
  - Puccinia symphoricarpi

SYMPHORICARPOS ALBUS
  Puccinia crandallii
  Puccinia symphoricarpi
  Septoria signalensis
SYMPHORICARPOS OCCIDENTALIS
  Lasiobotrys lonicerae
  Microsphaera diffusa
  Puccinia crandallii
  Puccinia symphoricarpi
SYMPHORICARPOS OREOPHILUS
  Puccinia crandallii
  Septoria oedospora
  Septoria signalensis
SYMPHORICARPOS RACEMOSUS
  Puccinia crandallii
SYMPHORICARPOS VACCINIOIDES
  Cercospora symphoricarpi
  Puccinia crandallii
  Puccinia symphoricarpi
  Septoria signalensis
SYNTHERIS PINNATIFIDA
  Puccinia acrophila
SYNTHYRIS WYOMINGENSIS
  Sphaerotheca humuli
TARAXACUM OFFICINALE
  Puccinia hieracii
  Ramularia taraxaci
  Sphaerotheca humuli
TARAXACUM VULGARE
  Puccinia hieracii
TETRAMERIUM HISPIDUM
  Puccinia tetramerii
THALICTRUM FENDLERI
  Puccinia recondita
  Tranzschelia thalictri
THALICTRUM OCCIDENTALE
  Puccinia clematidis
  Puccinia recondita
  Puccinia rubigo-vera
THELYPODIUM LASIOPHYLLUM
  Peronospora parasitica
THERMOPSIS DIVARICARPA
  Ascochyta thermopsidis
  Cercospora thermopsidis
  Erysiphe polygoni
THERMOPSIS RHOMBIFOLIA
  Cercospora thermopsidis
THLASPI MONTANUM
  Puccinia monoica
TRAGOPOGON PORRIFOLIUS
  Albugo tragopogonis
TRIFOLIUM ANEMOPHILUM
  Uromyces minor
TRIFOLIUM DASYPHYLLUM
  Uromyces minor
TRIFOLIUM HYBRIDUM
  Polythrincium trifolii
TRIFOLIUM LONGIPES
  Erysiphe polygoni
  Ramularia trifolii
  Uromyces minor
TRIFOLIUM PARRYI
  Phyllosticta alpinicola
  Uromyces minor
TRIFOLIUM RYDBERGII
  Ramularia trifolii
TRIGLOCHIN MARITIMA
  Puccinia aristidae
TRISETUM SPICATUM
  Puccinia monoica
  Puccinia recondita
  Puccinia rubigo-vera
TRITICUM AESTIVUM
  Heterosporium avenae
TROLLIUS ALBIFLORUS
  Cylindrosporium montenegrinum
  Phyllosticta trollii

URTICA DIOICA
  Puccinia caricina
URTICA GRACILIS
  Cylindrosporium urticae
  Puccinia caricina
  Puccinia caricis
URTICA GRACILENTA
  Septoria urticae

VACCINIUM SP.
  Pucciniastrum goeppertianum
VACCINIUM CAESPITOSUM
  Pucciniastrum goeppertianum
  Pucciniastrum vaccinii
VACCINIUM MEMBRANACEUM
  Exobasidium vaccinii-uliginosi
  Pucciniastrum goeppertianum
  Pucciniastrum myrtillii
  Pucciniastrum vaccinii
VACCINIUM OREOPHILUM
  Microsphaera alni
  Pucciniastrum myrtillii
VACCINIUM SCOPARIUM
  Exobasidium vaccinii
  Exobasidium vaccinii-uliginosi
  Pucciniastrum goeppertianum
  Pucciniastrum myrtillii
  Pucciniastrum vaccinii
VALERIANA CERATOPHYLLA
  Aecidium sp.
VALERIANA EDULIS
  Cercoseptoria valerianae

  Puccinia dioicae
VALERIANA FURFURESCENS
  Erysiphe cichoracearum
VALERIANA OCCIDENTALIS
  Puccinia dioicae
VERATRUM CALIFORNICUM
  Cylindrosporium veratrinum
  Phyllosticta melanocarpa
  Puccinia veratri
VERBENA SCABRA
  Septoria verbenae
VERONICA AMERICANA
  Entyloma veronicae
VERONICA WORMSKJOLDII
  Puccinia wulfeniae
VICIA AMERICANA
  Uromyces coloradensis
  Uromyces fabae
VICIA TRIFIDA
  Microsphaera alni
VIGUIERA DENTATA
  Coleosporium viguierae
  Puccinia abrupta
  Puccinia calanticariae
VIGUIERA MULTIFLORA
  Puccinia aemulans
  Puccinia enceliae
VIOLA SP.
  Puccinia violae
  Septoria violae
VIOLA CANADENSIS
  Puccinia violae
  Sphaerotheca humuli
VIOLA LINGUAEFOLIA
  Ramularia ionophila
VIOLA NUTTALLII
  Ramularia ionophila
VIOLA RUGULOSA
  Sphaerotheca humuli
VIOLA RYDBERGII
  Puccinia violae
VIOLA VALLICOLA
  Ramularia ionophila
WYETHIA AMPLEXICAULIS
  Cylindrosporium wyethiae
  Didymaria conferta
  Didymaria wyethiae
WYETHIA ARIZONICA
  Puccinia balsamorhizae
WYETHIA HELIANTHOIDES
  Sphaerotheca humuli

XANTHIUM ECHINATUM
  Puccinia xanthii
XYLORRHIZA GLABRIUSCULA
  Puccinia grindeliae
XYLORRHIZA PARRYI
  Puccinia grindeliae

YUCCA SP.
  Torula herbarum
YUCCA BREVIFOLIA
  Kellermannia major
YUCCA ELATA
  Kellermannia yuccaegena
YUCCA GLAUCA
  Coniothyrium concentricum
  Didymosphaeria clementsii
  Kellermannia anomala
  Kellermannia yuccaegena
  Phragmodothis conspicua

ZAUSCHNERIA CALIFORNICA
  Septoria gaurina
ZYGADENUS ELEGANS
  Puccinia grumosa
ZYGADENUS GRAMINEUS
  Puccinia grumosa
  Uromyces zygadeni

ON ARTIFICIAL MEDIUM
  Emericellopsis stolkiae

ON DUNG
  Lasiobolus pilosus

ON GROUND
  Amanita muscaria
  Boletus edulis
  Boletus versipellis
  Calvatia cyathiformis
  Cantharellus cibarius
  Clavaria flava
  Clavaria pistillaris
  Clavaria purpurea
  Clitocybe infundibuliformis
  Cortinarius flavifolius
  Cortinarius glaucopoides
  Cortinarius mucifluus
  Gasterocybe lateritia
  Geopyxis cupularis
  Helvela infula
  Hydnum imbricatum
  Hygrophorus calophyllus
  Lactarius deliciosus
  Polyporus circinatus
  Polyporus ovinus
  Polyporus tomentosus
  Pseudoplectania nigrella
  Secotium agaricoides
  Sepultaria aurantia
  Thelephora caryophyllea

ON WOOD

- Auricularia auricula-judae
- Coniophora corrugis
- Corticium byssinum
- Dasyscypha arida
- Exidia saccharina
- Fomes pini
- Guepiniopsis alpinus
- Lachnellula chrysophthalma
- Polyporus abietinus
- Stereum sanguinolentum
- Trametes mollis

MYCOTAXON

Vol. X, No. 1, pp. 93-98 October-December 1979

CONIDIUM ONTOGENY AND MORPHOLOGY OF *CERCOSPORA KIKUCHII*

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Summary

Conidium development and morphology of an isolate of *Cercospora kikuchii* (American Type Culture Collection 36864) recovered from purple-stained soybean seeds (*Glycine max* (L.) Merr. cv. Amsoy) was studied on carrot leaf-decoction agar (CLDA) and on artificially inoculated soybean tissues. The morphological characters of the isolate did not vary between the two substrates. The conidia developed holoblastically from integrated, sympodial conidiogenous cells within 36 hours (optimum: 4 to 5 days) on CLDA under 12 hours of artificial light at room temperature (23 to 27C). Mature conidia varied in size and septation. The conidiophores attained a length of 2 mm in 7 days on CLDA. The distance between conidial scars on conidiophores varied from 10 to 150 µm.

Introduction

Cercospora kikuchii (Matsumoto & Tomoyasu) Gardner, the causal fungus of purple seed stain of soybean (*Glycine max* (L.) Merr.), was discovered by R. Kikuchii in 1922 and described by Matsumoto and Tomoyasu in 1925 as *Cercosporina kikuchii* (7). Garner (2) transferred the fungus to the genus *Cercospora* in 1926. Sporulation on artificial media was not obtained (1,6,7) until the development of conidia was reported on carrot leaf-decoction agar (CLDA) by Kilpatrick (4) and on dead soybean tissue by Vathokas and Walters (9). Most of the morphological descriptions of *C. kikuchii* were made from infected plant tissues (5,6,7) with a discussion of the sympodial development but conidium ontogeny was not illustrated. We report on the morphology and development of conidiophores and conidia of an isolate of *C. kikuchii* on CLDA and infected soybean tissues.

Materials and Methods

Cercospora kikuchii, labeled Ck-1 (American Type Culture Collection 36864), was recovered from soybean seeds with symptoms of purple seed stain and maintained on Difco potato-dextrose agar (PDA). Herbarium material of this isolate is preserved in the Illinois Natural History Mycological Herbarium as ILLS 37919. Carrot leaf-decoction agar (CLDA) (4) was prepared for the inoculum multiplication and microscopic studies. Carrot leaf-decoction plates were inoculated by using a soft sterile brush containing a mycelial suspension of the test fungus from PDA cultures incubated under 12 hours of alternating light and dark at room temperature (23 to 27C). The light source consisted of two 20-watt cool white fluorescent bulbs set 30 cm apart. Soybean (cv. Amsoy 71) plants were sprayed with a suspension of mycelia and conidia (ca. 5,000/ml) in the field at early-pod stage (R_6) (3).

The morphology and ontogeny were studied in culture on CLDA and on infected soybean (cv. Amsoy) leaves, stems and seeds. Specimens of the test fungus were prepared and preserved for light microscopy study using Amann's mounting fluid-lactophenol containing 0.05% cotton blue (8). Measurements were taken with a micrometer on an Olympus BHA microscope.

Results and Discussion

ONTOGENY: The Ck-1 isolate of *C. kikuchii* produced conidia and conidiophores on CLDA within 36 hours after inoculation and within 24 hours on infected soybean leaves, stems and seeds. The conidiophores were in fasciles, several to more than 20 stalks on a stroma. Conidiophores were yellowish-brown to dark-brown at the base with a gradual decrease in coloration up the stalk until the tips appeared hyaline. No conidial scars were observed on newly formed conidiophores (Fig. 1), but were evident on the old conidiophores (Figs. 2 and 3). The distance between scars varied from 10 to 150 µm. Conidiophores reached a length of over 2 mm from CLDA cultures after 7 days.

A holoblastic conidium was produced at the tip of all conidiophores (Fig. 4). As the conidium matured, a crosswall was formed at the attachment site of the conidium to the conidiophore (Fig. 5). Mature conidia were detached easily and the conidiophores proliferated sympodially (Fig. 7) to form another conidiogenous locus at the new apex (Fig. 5). Conidia were hyaline, acicular, truncate, straight or curved, multiseptate and had a thickened hilum (Fig. 8). Conidia may develop in an alternating manner but it is not a persistent feature (Figs. 3 and 6). Five or six conidia may be produced from one conidiophore in 7 days. Conidia germinated in distilled water with one to many germtubes within 2 to 3 hours (Fig. 9).

MORPHOLOGY: The size of conidiophores and conidia did not vary with substrates (Table 1), but were generally larger than those reported from soybean in Japan (7) and smaller than those from soybeans in North Carolina (6). The range and size of conidiophores and conidia *in vitro* from Japan were 4 to 6 x 85 to 200 µm and 4 to 5 x 70 to 164 µm with 0 to 22 septations, respectively; and those from North Carolina were 3.2 to 6.1 x 36 to 286 µm and 1.3 to 6.1 x 38.8 to 445 µm with 2 to 49 septations, respectively. The development and morphology of *C. kikuchii* may be influenced by environmental factors such as substrate, pH and relative humidity (6,7) and this could account for, in part, the differences previously cited and reported in this paper.

Acknowledgments

The research was supported in part by the Illinois Agricultural Experiment Station and the International Soybean Program (INTSOY). The authors thank J. Lee Crane, Mycologist, Illinois Natural History Survey, Urbana, IL 61801 for critically reviewing the manuscript.

Table 1. Size and occurrence of conidial scars on conidiophores and size and number of septations in conidia of *Cercospora kikuchii* grown on various substrates.

Substrate[1]	Measurements in µm[2]		Range in occurrence	
	Conidiophores	Conidia	Scars per conidiophore	Septations per conidia
CLDA	3.2 - 5.0 x 122 - 448	2.5 - 3.2 x 85.8 - 312	0 - 6	1 - 23
Soybean				
Leaves	3.2 - 5.6 x 101 - 644	2.0 - 3.0 x 84 - 267	0 - 2	2 - 19
Stems	2.8 - 5.2 x 78 - 435	1.5 - 2.6 x 72 - 280	0 - 2	2 - 20
Seeds	2.9 - 5.2 x 57 - 464	2.6 - 3.9 x 91.2 - 299	0 - 2	1 - 22

[1] CLDA = Carrot leaf-decoction agar; soybean leaves, stems and seeds from infected soybean plants grown in the field.

[2] Averages based on 50 measurements.

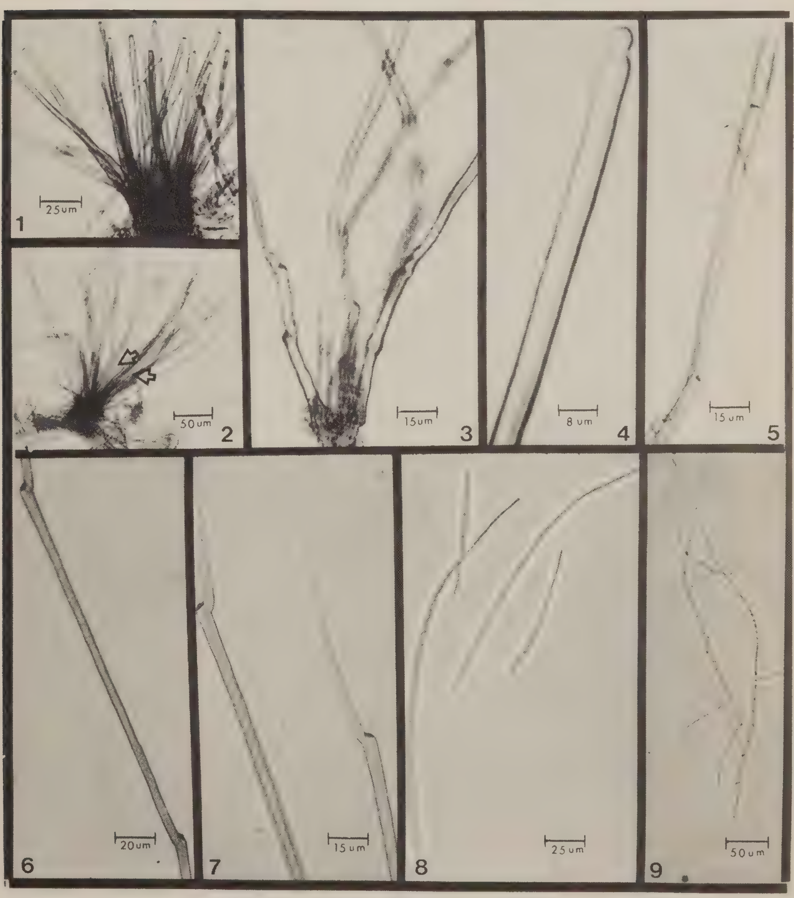
Figures 1-9. *Cercospora kikuchii* grown on carrot leaf-decoction agar and inoculated soybean tissues. 1. Fascicle of young conidiophores arising from a stroma. 2. Fascicle of conidiophores from a stroma showing conidial scars (arrows). 3. Fascicle of mature conidiophores illustrating the geniculate arrangement of the prominant conidial scars. 4. Holoblastic development of a conidium at the apex of a conidiophore. 5. Delimitation of a septum between developing conidium and conidiophore. 6. Conidiophore illustrating the alternate arrangement of the conidial scars. 7. Sympodial development of the conidiophores. 8. Mature conidia. 9. Germination of conidia.

Literature Cited

1. CRANE, J. L. and H. W. CRITTENDEN. 1967. Growth of *Cercospora kikuchii* on various media. Pl. Dis. Reptr. 51:112-114.

2. GARDNER, M. W. 1926. Indiana plant diseases. Proc. Indiana Acad. Sci. 36:231-247.

3. HANWAY, J. J. and H. E. THOMPSON. 1971. How a soybean plant develops. Iowa State Univ. Coop. Ext. Ser. Spec. Rept. 53(Rev.):1-17.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4. KILPATRICK, R. A. and H. W. JOHNSON. 1956. Sporulation of *Cercospora* species on carrot leaf decoction agar. Phytopathology 46:180.

5. MULDER, J. L. and P. HOLLIDAY. 1975. *Cercospora kikuchii.* CMI descriptions of pathogenic fungi and bacteria. No. 446.

6. MURAKISHI, H. H. 1961. Purple seed stain of soybeans. Phytopathology 41:305-318.

7. MATSUMOTO, T. and R. TOMOYASU. 1925. Studies on purple speck of soybean seed. Ann. Phytopathol. Soc. Japan 1:1-14.

8. TUITE, J. 1969. Plant Pathological Methods, fungi and bacteria. Burgess Publ. Comp. Minneapolis, Minn.

9. VATHAKOS, M. G. and H. J. WALTERS. 1978. Conidial production by *Cercospora kikuchii* in culture. Amer. Phytopathol. News 12(9):212.

MYCOTAXON

Vol. X, No. 1, pp. 99-104 October-December 1979

COMPLEXIPES MONILIFORMIS: A NEW GENUS AND SPECIES TENTATIVELY PLACED IN THE ENDOGONACEAE[1]

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While investigating the Endogonaceae of Iowa, I sampled soil from the Ames High School Pinewood, Ames, Iowa. This area is a small plantation of red pine (*Pinus resinosa* Ait.), Scots pine (*P. sylvestris* L.), and eastern white pine (*P. strobus* L.) about 35 years old. The ground cover consists of virginia creeper (*Parthenocissus quinquefolia* (L.) Planch.) in a dense monospecific mat. The soil was sampled for endogonaceous spores with a centrifugation and sugar-flotation technique similar to that of Jenkins (1964). *Glomus fasciculatus* (Thaxter sensu Gerdemann) Gerdemann & Trappe and *G. etunicatus* Becker & Gerdemann were present in great abundance, along with another rather ornate spore, which is here named and placed in the new genus *Complexipes*. Specimens have been deposited in the Oregon State University Herbarium (OSC) and in the Iowa State University Herbarium (ISC). In addition, I have retained some in my personal collection (Walker #27).

Complexipes moniliformis Walker gen. et sp. nov. Fig. 1

Sporocarpia ignota. Chlamydosporae globosae, 55-110 µm in diam, ferruginae vel atrocinnamomeae, tunica stratis tribus: exteriore ± 1 µm, medio usque ad 6 µm, interiore 0.5-1 µm. Pagina sporae rugosa vel papillosa, altitudo ornamenti usque ad 4 µm. Hypha affixa papillosa vel interdum rugosa, bitunicata, septata cellusis usque ad novem, ad septa constricta, cellula ad basim sporae cupulata, usque ad 24 x 24 µm. TYPUS: Ames, Iowa, U.S.A., Walker #27 (OSC).

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[1] Journal Paper No. J-9539 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 2294. Taken from a Ph.D. dissertation submitted to the Graduate Faculty of Iowa State University, 1979.

Sporocarps unknown. *Chlamydospores* borne singly in the soil, terminal on a single hyphal attachment, globose, 55-110 µm in diam, orange-brown to dark red-brown. Spore wall three-layered, with an outer layer 0.5-1 µm thick fused to a middle layer up to 6 µm thick and an inner layer 0.5-1 µm thick. Outer layer often difficult to distinguish even in crushed specimens, ornamented with crowded folds and papillae up to 4 µm high.

Subtending hypha with a thick 2-layered wall and up to nine cells formed by septa derived from the inner wall, the cells slightly constricted at the septa and readily detaching from the spore base to leave a light-colored circular scar; hyaline to pale yellow, the subtending cell usually brown tinted, papillate to occasionally rugose, the ornamentation less dense than on the spore. Subtending cell usually cup-shaped, up to 24 x 24 µm.

Hyphae in the soil pale yellow, thick-walled, sparsely low rugose, coenocytic, up to 6 µm in diam, the walls up to 1 µm thick.

DISTRIBUTION AND HABITAT.

In soils around roots of virginia creeper (*Parthenocissus quinquefolia*) in a pine plantation. Mosse & Bowen (1968) described a fungus that probably is *C. moniliformis* as a "crenulate spore" from soils in New Zealand and Australia, but they gave no details of associated plants. Thapar & Khan (1973) also recorded and figured a similar spore from their survey of some Indian soils. Their records were from forest nurseries on grassland soils in Kerala State, but host species were not identified. Hall (1977) discovered a similar species in a disused garden in New Zealand and, in the same publication,

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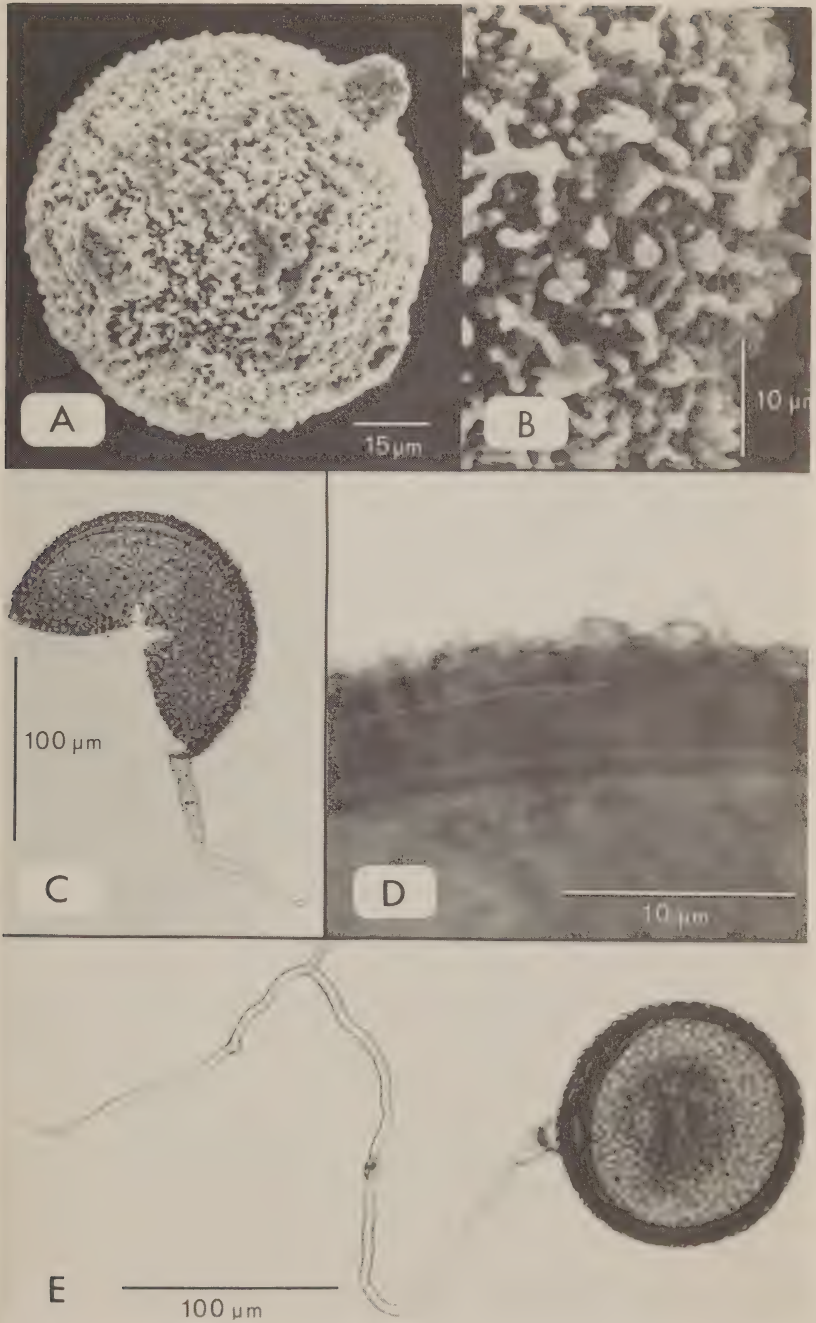
Figure 1. *Complexipes moniliformis.*

(A) Scanning electron micrograph of a mature spore showing cupulate suspensor-cell. (B) Detail of complex outer wall coating. (C) Light micrograph of a mature spore showing moniliform subtending hypha. (D) Detail of wall structure. (E) Mature spore attached to coarse non-septate hypha.


A
15 µm
B
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C
D
10 µm
E
100 µm

cited Dr. Barbara Mosse as having found it in Germany. Wilcox *et al.* (1974) describe and excellently illustrate this fungus (as BDG-58) in detail and also refer to Mikola's "E-57" and "E strain" as the same species. Both "BDG-58" and the "E" fungi were associated with the roots of pine trees.

MYCORRHIZAL ASSOCIATIONS.

Forms ectendomycorrhizae with pines (Wilcox *et al.*, 1974). Associated in the field at the type location with mycorrhizal roots of pines and virginia creeper.

ETYMOLOGY.

Genus - Latin, "complex base" referring to the complex form of the subtending hypha.

Species - Latin, "necklace-like", also referring to the subtending hypha.

DISCUSSION.

Complexipes differs from other genera in the Endogonaceae by having a moniliform subtending hypha and a highly ornamented outer coat, which seemingly is secreted by the middle wall layer and becomes more complex with maturity. *Gigaspora* species have azygospores produced on a bulbous suspensor cell, which often is formed terminally on a septate hypha. *Complexipes* chlamydospores are borne on a cupulate cell and, whereas the hyphae of *Gigaspora* do not break readily at the septa, the moniliform cells of *Complexipes* are readily separable. Individual *Glomus* and *Sclerocystis* chlamydospores have some similarities with those of *Complexipes*, but do not have the cup-shaped suspensor cell and moniliform subtending hypha. When detached from their subtending hypha, *Complexipes* spores could be mistaken for similarly detached spores of *Gigaspora heterogama* (Nicol. & Gerd.) Gerdemann & Trappe or for *Acaulospora* spores. Care should be taken to see that sessile spores in the Endogonaceae are correctly identified. Fortunately, numerous spores are generally present in a soil sample, and careful comparison of all spores from the sample usually will lead to correct conclusions.

Wilcox and his co-workers have shown that *C. moniliformis* is culturable and has septate hyphae. However, the small amount of hyphae found in my field collections is but sparsely septate (Fig. 1E) and is coarse and thick-walled. It appears more akin to the coenocytic hyphae of the Endogonaceae than to the more regularly septate hyphae of most ascomycetes. Hall (1977) suggested that it might be an ascomycete, but in the same paper, he described the hyphae as being aseptate. As far as I can judge from the plates in Wilcox *et al.*, some lengths of hyphae in their cultures were aseptate. Septa are not uncommon in hyphae of the Endogonaceae.

That the BDG-58 fungus of Wilcox *et al.* was ectendomycorrhizal rather than endomycorrhizal does not preclude its membership in the Endogonaceae. Members of the family form endo- and ectomycorrhizae, some species are seemingly saprobic, and the mycorrhizal relationships of yet others are unknown (Gerdemann & Trappe, 1974). The fungus sporulated only when associated with plant roots (Wilcox *et al.*). This also is in line with the behavior of the culturable *Endogone eucalypti* nom. ined. (Warcup, 1975). In addition, the mycorrhizae formed by the BDG-58 fungus (as illustrated by Wilcox *et al.*) are not altogether unlike those formed by *Glomus* or *Gigaspora* under some circumstances, despite the authors' comments to the contrary. The intracellular structures could certainly be considered as arbuscular in general appearance, albeit somewhat coarse. The "Hartig net" is analogous in some ways to the often highly septate intercellular hyphae of vesicular-arbuscular mycorrhizae. The description of the sheath suggests an apparent similarity to that formed on *Eucalyptus* by *Endogone eucalypti*.

I have concluded, therefore, that *Complexipes* sufficiently resembles fungi already placed in the Endogonaceae to be provisionally placed as a new genus in that family.

ACKNOWLEDGEMENTS.

I wish to thank Dr. James M. Trappe for his helpful comments, for preparing the Latin diagnosis, and for suggesting the generic and specific names.

LITERATURE CITED.

GERDEMANN, J. W. & J. M. TRAPPE. 1974. The Endogonaceae in the Pacific Northwest. *Mycologia Memoir* No. 5 (New York Bot. Gard.).

HALL, I. R. 1977. Species and mycorrhizal infections of New Zealand Endogonaceae. *Trans. Br. mycol. Soc.* 68: 341-356.

JENKINS, W. R. 1964. A rapid centrifugal-flotation technique for separating nematodes from soil. *Plant Dis. Rep.* 48:692.

MOSSE, B. & G. D. BOWEN. 1968. A key to the recognition of some *Endogone* spore types. *Trans. Br. mycol. Soc.* 51:469-483.

THAPAR, H. S. & S. N. KHAN. 1973. Studies on endomycorrhiza in some forest species. *Proc. Indian Nat. Sci. Acad.* Part B. 39:687-694.

WARCUP, J. H. 1975. A culturable *Endogone* associated with Eucalypts. IN: *Endomycorrhizas.* (ed. Sanders, Mosse & Tinker). London & New York. Academic Press. 626pp.

WILCOX, H. E. R., R. GANMORE-NEUMANN, & C. J. K. WANG. 1974. Characteristics of two fungi producing ectendomycorrhizae in *Pinus resinosa*. *Can. J. Bot.* 52:2279-2282.

MYCOTAXON

Vol. X, No. 1, pp. 105-115 October-December 1979

FUNGI OF THE GULF COAST I. TWO NEW SPECIES OF *HYGROPHORUS* SECTION *HYGROCYBE*[1]

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SUMMARY

Two new species of *Hygrophorus* section *Hygrocybe* from the Gulf Coast of Mississippi are described. *Hygrophorus mississippiensis* appears to have affinities with species known from the tropics notably *H. firmus* var. *trinitensis* Dennis and *Hygrocybe mexicana* Singer. *Hygrophorus chamaeleon* possesses a two-layered cuticle. As the deeper stratum has pigmented hyphae, the effects of the presence or absence of water in the interstices of the uppermost layer of hyaline hyphae has a marked effect on the pileus color of this agaric. This property appears to be unique and the optical aspect of this phenomenon is discussed. Also, pigment separations by means of paper chromatography are described and compared with other Hygrocybes. Color data is given in Munsell notation and both ISCC-NBS and Ridgway equivalents are given where possible.

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[1] Based in part on a dissertation submitted to the Graduate School of the University of Massachussetts in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

The mycological flora of the Mississippi Gulf Coast has not had much study. The only information on Gulf Coast agarics is that available from studies of Murrill in Florida (for a synopsis of these studies see Weber 1961 and Murrill 1972), that of Thiers (1956, 1957, 1958 and 1959a) from east Texas and Jenkins (1978) who has studied some elements of the *Amanita* flora from the southeast. The Boletaceae have been partially studied by Singer (1945-1947) and Thiers (1956 and 1959b).

There is a greater diversity of vegetation in the Gulf Coastal Plain than in the adjoining piedmont and mountains (Wells, 1928 and 1942), and the plant communities of the Coastal Plain are most highly developed in the lower southern part. Also, this area is an ecotone between the temperate and subtropical climate zones (Watson, 1975).

As a result of the diversity of the higher plant communities and the transitional nature of this area, it is to be expected that the Gulf Coastal Plain might support an endemic agaric population or have Neotropical representatives. This study represents a contribution to an analysis of the higher fungal flora of this region.

Original color data were obtained in Munsell notation through the use of the Munsell Book of Color (Munsell Color Company, Inc., 1967). For the descriptive narrative, the ISCC-NBS color names have been used (Kelly and Judd, 1976, Inter-Society Color Council, 1965). The original Munsell notations are given at the end of the macroscopic portions of the descriptions with the closest Ridgway (Ridgway, 1912) equivalent (Rayner 1970; Cibula, unpublished data) parenthesized immediately after the Munsell notation, e.g. 6.25R 3/12 (carmine).

Hygrophorus mississippiensis Cibula sp. nov.
Fig. 1 A, B, E.

Pileus 5-8 (10) mm latus, tenuis, convexus demum applanatus vel depressus, puniceus, ad marginem luteus demum albus; siccus et squamulosus; caro pilei tenuis, rubella. Lamellae arcuatae, subdistantes, crassae, uncinatae, latae, triangulares, roseobubalinae, salmoneo-pallidae vel ferrugineae. Stipes 2.5-3.0 cm longus, 1.0 mm latus, cylindricus, udus vel siccus, cavus, ruber. Sporae in cumulis albae, haud amyloideae, ellipsoideae vel subovatae, leves, 7.5-8.4 x 4.7-5.8μm. Basidia tetraspora, clavata hyalinis, 31-38 x 7-9.4μm. Fibula adsunt. Specimen typicum legit prope Saucier, MS, 8 August 1974 in Herb. Mass conservatum est. Wm. Cibula n 485.

Pileus 5-8 (10) mm broad, convex to flattened or becoming broadly convex-depressed; color vivid red to deep red, somewhat lighter near the margin with a very narrow white to yellowish margin in some mature specimens (which contrasts with the deep red of the disc), red color retained well in older basidiocarps, not viscid, but surface dry and composed of radially arranged, highly pigmented hyphae which group together in upturned fascicles giving the pileus a scurfy to squamulose appearance, this aspect more pronounced near the disc where the squamules have a cirumferential arrangement and increase in size towards the center. Context thin, hygrophanous, reddish.

Lamellae convexly arcuate, subdistant, emarginate, with an acuminate decurrent tooth on the stipe, thick, ± triangular, with one tier of lamellulae; color pale yellow to light yellowish brown occasionally with a slight reddish tint giving a light to moderate yellowish pink color.

Stipe 2.5-3 cm long, about 1 mm thick, cylindric, over entire length somewhat lighter in color than pileus, darker near base, lighter near or at apex, not viscid, glabrous with a silken sheen, hollow; interior context fibrous, concolorous with exterior.

Munsell color data: Pileus - 6.25R 3/12 (carmine) to 7.5R 3/12 (sl. deeper than scarlet red), lighter near margin, 7.5R 3.2/10 (no Ridgway equivalent). Lamellae - 7.5YR 7.5/5 (close to "light pinkish cinnamon") to 10YR 9/4 (close to "pale ochraceous-salmon"), occasionally with a slight reddish hue 10R 5/8 (near "vinaceous rufous"). Stipe - 7.5R 4/14 (close to "Nopal red"), 10R 5/10 (sl. darker than Carnelian Red) near juncture with pileus.

Spore deposit chalky white; spores inamyloid, hyaline in water mounts; ellipsoid to subovoid, 7.5-8.4 x 4.7-5.8 μm, thin-walled, apiculus distinct; content of fresh spores (in water) granular. Basidia 31-38 x 7-9.4μm, clavate, 4-spored as far as noted, monomorphic. Pleurocystidia apparently absent; cheilocystidia apparently absent.

Gill trama of parallel hyphae ± 12μm wide, hyaline in water mounts; clamps present. Context hyphae irregularly inflated (the cells 25-40 x ± 25μm), hyaline in water mounts of fresh material. Cuticular hyphae strongly pigmented, thin-walled, the cells 95-205 x 18-19μm, the pigment evenly distributed throughout the cell. The hyphae immediately below the strongly pigmented surface hyphae are similar in size and shape, but when seen individually, appear hyaline; seen in groups a yellow tint is present.

Habit, habitat and distribution: Gregarious beneath mixed hardwood and pine, adjacent to Loblolly Pine, Block IV, Plot 4, Fertilization Study Plots, Harrison Experimental Forest, De Soto National Forest, Saucier, MS: on a raised mound of earth and stumps, and in leaf litter in mixed bottomland hardwoods, Harrison Experimental Forest. One collection (No. 485), consisted of numerous sporophores.

Material Studied: No. 485, De Soto National Forest, Saucier, MS, 8 August 1974; No. 554, De Soto National Forest, Saucier, MS, 16 June 1975; Nos. 608 and 610, De Soto National Forest, Saucier, MS, 9 July 1976; No. 711, De Soto National Forest, Saucier, MS, 8 Sept. 1977.

Observations: Both rhodohygrocybin and flavohygrocybin are abundant (Cibula, 1976; R_f = 0.18 and 0.48, acetone/H_2O 6:4), and additionally another yellow pigment (R_f = 0.24), is moderately abundant. This agaric appears to be closely related to *H. firmus* var. *trinitensis* Dennis (Dennis, 1953; Hesler and Smith, 1963). Basidia lengths agree and spore sizes fall within the range for var. *trinitensis*, but this variety has coral red lamellae, and is at most only slightly scurfy over the pileus. There is also close similarity to *Hygrocybe mexicana* Singer (Singer, 1958) but this species is reported as having a glabrous pileus. Spore and basidia sizes agree. *H. mississippiensis* differs from *H. firmus* Berkeley and Broome var. *firmus* (Berkeley and Broome, 1871; Singer, 1957; Hesler and Smith, 1963) in not having dimorphous basidia and spores. Furthermore, in their original publication, Berkeley and Broome report that the pilei of their collection (No. 880) was yellow and minutely tomentose. In light of this, more recent interpretations of *H. firmus* (and its variatal forms) are probably incorrect. It is necessary to have a magenta pigment (rhodohygrocybin) in addition to yellow to produce a red color. This represents a significant metabolic difference between yellow and red Hygrocybes. For this reason, this species is not considered as a variety of *H. firmus* in the modern sense and it is certainly different from *H. firmus* sensu Berkeley and Broome. Although apparently related to *H. cantharellus*, (Schw.) Fr. this agaric is distinguished by its more diminutive stature, more saturated red coloration of the pileus and stipe, a probably more southern distribution, as well as the rather strong yellow pigment band at $R_f = 0.24$ (acetone/water 6:4) noted on chromatograms prepared from crude pigment extracts. Also, this species does not "fit" any of the seventeen Malayan varieties of *H. firmus* described by Corner (1936).

Hygrophorus chamaeleon Cibula sp. nov.
Fig. 1 C, D.

Pileus 1.3-4 cm latus, convexus demum convexo-depressus, postea late depressus; miniatus demum in sicco bubalinus, aliquot pilei cum viridi-flavus; siccus, fibrillosus; caro pilei tenuis, persicinus. Lamellae distantes crassae adnatae demum decurrentes, luteolae, flavovirens vel roseae. Stipes 3-6.5 cm longus, 5-9 mm latus, ruber, cylindraceus, udus, glaber, cavus. Sporae in cumulis albae, haud amyloideae, 12-17 x 7-10µm et 6.5-8.5 x 4.5-5 µm, leves, dimorphae. Basidia 35-40 x 6-9µm, clavata. Cheilocystidia numerosa, clavata, 45-65 x 9.4-12.5µm. Cutis pileorum bistratosus. Fibulae adsunt. Specimen typicum Cibula n. 589 in Herb. Mass conservatum est; legit prope Saucier, MS, 8 August 1974.

Pileus: 1.3-4 cm broad; plano-convex to convex-depressed, becoming depressed; margin finally upturned and then infundibuliform; color very variable from deep red to dark olive buff with some caps showing shades of greenish-yellow, this variability due both to drying and to areas which were covered by debris. When moist, dark red or deep red to dark reddish brown and moderate reddish brown; some at the extreme margin and where the pileus was rimose were a moderate yellow in color. When dry, pileus then light reddish brown to brownish orange, with one very dry pileus a dark grayish-yellow. Where covered by leaves, other debris or adjacent pilei, pale yellow to light olive green with some a light olive gray, others more saturated, moderate yellow and light olive also noted; entire surface covered with abundant radially arranged hyphae which give a fibrillose to fibrillose-squamulose disc; not viscid; at times rimose; margin even, somewhat eroded to eroded-plicate in older sporophores. Context: thin; hygrophanous; yellowish to reddish in color.

Lamellae: broadly adnate to decurrent becoming decurrent in maturity; also quite variable in color both among differing basidiocarps and on a single specimen; pale yellow observed as well as grayish-reddish-orange, while others exhibit greenish-yellow hues with yellowish-gray, grayish-greenish yellow and pale greenish-yellow all being observed; three tiers of lamellulae; distant to subdistant; the edges, especially in older material, are noticeably eroded, appearing almost serrate.

Stipe: 3-6.5 cm long, 5-9 mm broad, red, upper third, dark red and moderate reddish-orange paling both above and below, becoming yellowish closer to the base, brownish-orange to light yellow while at the base, the color nearly white; interior hygrophanous, light yellow; terete, equal to somewhat enlarged near the apex; not viscid; glabrous with a silken sheen; hollow.

Munsell color data: Pileus when moist, 5R 3/4 (somewhat lighter than "maroon") to 7.5R 2/4 (close to "maroon") to 7.5R 3/10 (between "garnet brown" and "carmine") to 10R 3/6 ("Morocco red") some yellowish areas 2.5Y 7/8 (close to "primuline yellow") at extreme margin and where pileus is rimose. When dry, pileus then 2.5YR 5/4 ("fawn color") to 2.5YR 5/8 (close to "ferruginous"), one very dry pileus 5Y 6/3.2 ("dark olive buff"); where covered by leaves, other debris or adjacent pilei, 2.5Y 8/2 (no equivalent, closest to "pale olive buff") to 2.5Y 6/2 (no equivalent) to 5Y 6/2 (between "light grayish-olive" and "dark olive buff") to 2.5Y 7/8 (close to "primuline yellow") to 5Y 5.4/6 (between "olive lake" and "pyrite yellow"). Lamellae variable, 5Y 9/3 (between "ivory yellow" and "cream colored") to 7.5Y 9/3 (closest to "massicat yellow"), some reddish, 10R 5/6 ("terra cotta") while others are 7.5Y 7/2 (no Ridgway equivalent) to 10Y 7/4 no Ridgway equivalent) to 10Y 9/4 ("sulfur yellow") all being observed. Stipe, upper third 7.5R 2.5/9 (no Ridgway equivalent, closest to "garnet brown") and 10R 5/10 (close to "carnelian red") near the base 5YR 5/8 (no Ridgway equivalent; lighter than "amber brown") to 5Y 8.5/8 (close to "empire yellow"); interior 5Y 8.5/6 ("baryta yellow").

Spores: chalky white in deposit; some 12-17 x 7-10µm, others 6.5-8.5 x 4-5.5µm very variable in size; thin-walled; smooth; ellipsoid to ovate; hyaline in KOH; inamyloid.

Basidia: hyaline; narrowly clavate, 35-40 x 6-9.4µm.

Cheilocystidia: numerous, clavate with a umbonate apex; contents granular; thick-walled, 45-65 x 9.4-12.5µm.

Gill trama: parallel; 115-170 x 14-18.7µm; hyaline.

Cuticle: distinctly two-layered, the uppermost composed of non-pigmented radially arranged hyphae which form a trichodermium; the hyphae 58-150 x 11.5-21µm; this hyaline to very pale yellow layer is 55-115µm deep. Second layer of radially arranged and interwoven hyphae, strongly pigmented a deep red; 47-150 x 16-21µm. Clamp connections: present on hyphae in gill trama.

Habit, habitat, and distribution: gregarious to subcespitose; found in low areas chiefly beneath sweet bay *Magnolia virginiana* in leaf litter, Mississippi Gulf Coast, summer. Materials Studied: No. 489, 20 August 1974; No. 555 and No. 556, 16 June 1975; No. 567, 24 July 1975; No. 571 and No. 572, 10 August 1975; No. 607, 9 July 1976; Nos. 712 and 713, 8 Sept. 1977 and No. 724, 22 Sept. 1977 all collections Harrison Experimental Forest, De Soto National Forest, Saucier, MS.

Observations: The larger spores (12-17 x 7-10µm) and the abundant cheilocystidia, suggest a relationship with *H. appalachianensis* but this *Hygrophorus* differs from this species and all others in the subgenus *Hygrocybe* examined in this study by both the hyaline trichodermium which overlay the pigmented hyphae of the cuticle, and by the extreme variability in spore size. The non-pigmented trichodermium is in part, responsible for the variable color observed in this agaric due to differing optical properties when wet or dry. When the sporophore is wet as for example, after a recent rain, water fills the interstices between these hyphae. Under these conditions, the differences in the index of refraction between the water, cell wall and cell contents ($\eta_1 = 1.33$ vs η_2 - 1.3-1.5) are not great. Hence, surface reflections from these hyphae are minimized allowing most of the light to pass through this layer and then to undergo preferential absorption of selected wavelengths from the pigmented hyphae below. However, when dry, air fills the interstices and now the situation is significantly different ($\eta_1 = 1.00$; $\eta_2 = 1.3\text{-}1.5$). Even at perpendicular incidence,[2] approximately 4% of the total light is reflected back to the observer from each air/cell wall surface for each hyphae encountered. The net result is that most of the illumination falling on the pileus is diffusely reflected back to the observer before preferential spectral absorption from the more deeply buried pigmented hyphae can occur.

This unusual optical property has not been observed in any other *Hygrocybe*. The observed greenish-yellow colors appear to be associated with those areas of the pileus which were occluded by other pileii or debris.

ACKNOWLEDGEMENTS

I thank Dr. Alexander H. Smith for his critical review of this manuscript and help with the Latin diagnoses and Dr. Howard E. Bigelow for his guidance and interest in the overall study of pigments in *Hygrophorus* of which this is a part. Dr. Jean Wooten deserves especial thanks for proof reading this manuscript in the author's absence, as does Mrs. Betty Aultman for preparing the camera-ready manuscript.

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[2] In the special case of perpendicular incidence, the reflection, R, from each surface, is given by:

$$R = \frac{(\eta_2 - \eta_1)^2}{(\eta_2 + \eta_1)^2}$$

where η_1 = index of refr. of first med.
η_2 = index of refr. of 2nd med.

As the angle of incidence deviates more and more from 90°, the reflection increases rapidly. A complete treatment of this optical aspect is given by Wood (1934, p. 406-412).

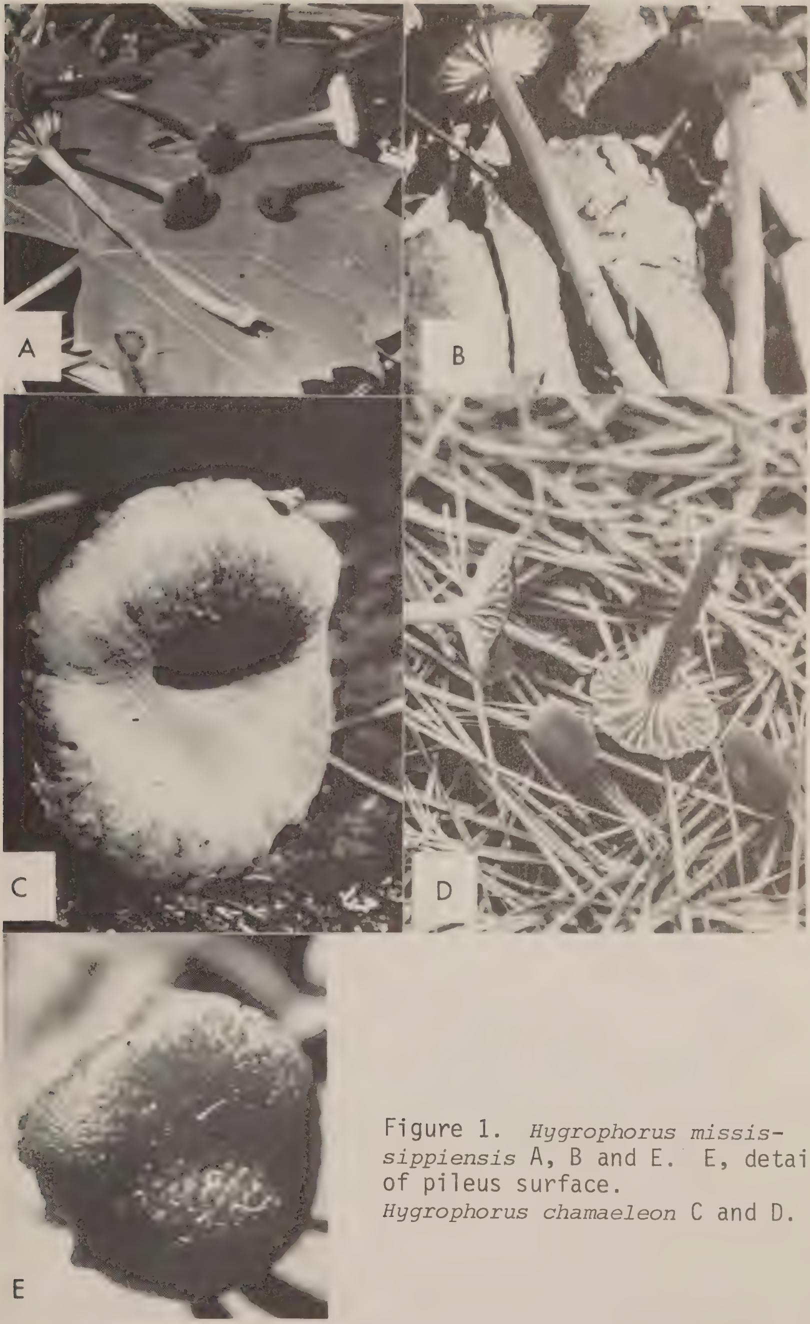

Figure 1. *Hygrophorus mississippiensis* A, B and E. E, detail of pileus surface.
Hygrophorus chamaeleon C and D.

LITERATURE CITED

Berkeley, M. and C. E. Broome. 1871. The fungi of Ceylon. J. Linn. Soc., Bot. 11:494-572.

Cibula, W. G. 1976. The pigments of *Hygrophorus* section *Hygrocybe* and their significance in taxonomy and phylogeny. Xerox University Microfilms, Ann Arbor, MI. 236 p.

Corner, E. J. H. 1936. *Hygrophorus* with dimorphous basidiospores. Trans. Brit. Mycol. Soc. 20:157-184.

Dennis, R. W. G. 1953. Some West Indian collections referred to *Hygrophorus* Fr. Kew Bull. 2:253-267.

Hesler, L. R. and A. H. Smith. 1963. North American species of *Hygrophorus*. University of Tennessee Press, Knoxville 416 p.

Inter-Society Color Council (ISCC) - National Bureau of Standards (NBS). 1965. ISCC-NBS color name charts illustrated with centroid colors, standard sample No. 2106. Supplement to NBS Circular 553. Office of Standard Reference Materials, National Bureau of Standards, Washington, D.C.

Jenkins, D. 1978. A taxonomic and nomenclatural study of the genus *Amanita* section *Amanita* for North America. Bibliotheca Mycologica, Band 57. J. Cramer.

Kelly, K. L. and D. B. Judd. 1976. Color. Universal language and dictionary of names. National Bureau of Standards (U.S.) Special publication No. 440, U.S. Government Printing Office, Washington, D.C. 184 p. Supersedes NBS Circular 553, (1955).

Munsell Color Company, Inc. 1967. Munsell book of color. Munsell Color Company, Baltimore, MD. 22 p. with approx. 1500 color standards.

Murrill, W. A. (compiled and edited by J. W. Kimbrough). 1972. Keys to the fleshy basidiomycetes of Florida. Institute of Food and Agricultural Sciences. University of Florida, Gainesville, FL. 199 p.

Rayner, R. W. 1970. A mycological colour chart. Commonwealth Mycological Institute. Kew, Surrey, England. 34 p. (Chart I, 9 sheets with color samples, Chart II, 8 sheets).

Ridgway, R. 1912. Color standards and color nomenclature. Washington, D.C. 43 p., 53 pl.

Singer, R. 1945-1947. The Boletineae of Florida with notes on extralimital species. I. The Strobilomycetaceae. Farlowia 2:97-141. II. The Boletaceae (Gyroporoideae). Farlowia 2:223-303. III. The Boletoideae of Florida. Am. Midland Naturalist, 37:1-135.

_____. 1957. Fungi mexicani, series prima - Agaricales. Sydowia 11:354-374.

_____. 1958. Fungi mexicani, series seconda - Agaricales. Sydowia 12:221-243.

Thiers, H. D. 1956. The Agaricaceae of the Pine Belt and adjacent areas in eastern Texas. Xerox University Microfilms, Ann Arbor, MI. 568 p.

_____. 1957. The agaric flora of Texas. I. New species of agarics and boletes. Mycologia 49:707-722.

_____. 1958. II. New taxa of white-and-pink-spored agarics. Mycologia 50:514-523.

_____. 1959a. III. New taxa of brown-and black-spored agarics. Mycologia 51:529-540.

_____. 1959b. Notes on the genus *Boletus* in Texas. Texas J. of Sci. 11:314-319.

Watson, G. 1975. Big Thicket plant ecology: an introduction. Big Thicket Museum Publ. Ser., No. 5, Saratoga, TX. 34 p.

Weber, G. F. 1961. William Alphonso Murrill; biography. Mycologia 53:543-557.

Wells, B. W. 1928. Plant communities of the coastal plain of North Carolina and their successional relations. Ecology 9:230-242.

_____. 1942. Ecological problems of the southeastern United States coastal plain. Bot. Rev. 8:533-561.

Wood, R. W. 1934. Physical optics. Dover edition publ. 1967, Dover Publications, Inc., New York, NY. 846 p.

MYCOTAXON

Vol. X, No. 1, pp. 116-132 October-December 1979

Mucilopilus, a New Genus of the Boletaceae, with Emphasis on North American Taxa[1]

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ABSTRACT

Studies of type specimens of *Porphyrellus* taxa revealed the existence of a small group of taxa significantly dissimilar to the type species of the genus. *Mucilopilus*, a new genus of the Boletaceae, is proposed to accomodate these taxa. *Mucilopilus conicus* is proposed as a new combination and *M. conicus* var. *reticulatus* is described as a new variety for North America. New combinations are also proposed for the extralimital taxa studied.

Introduction

Karsten (1881) circumscribed the genus *Tylopilus* as "...*sporae roseae...tubuli stipitati, adnati.*" Gilbert (1931) described the genus *Porphyrellus* as encompassing those taxa with red-brown to purple-brown spores and a dry pileus among other characters. McNabb (1967) proposed *Porphyrellus viscidus*, a taxon whose apparent characters were intermediate between *Tylopilus* and *Porphyrellus*, and based on the strength of the spore characters alone, he proposed Sect. *Pseudotylopili* of *Porphyrellus*.

Fries (1821) in his circumscription of *Boletus felleus*, (type species of *Tylopilus*), indicated that the pileus was dry, and Horak (1968) indicated that the pileus cuticle was composed of cylindric, thin-walled, hyaline, non-gelatinous hyphae. Fries (1835) circumscribed *Boletus porphyrosporus* (type species of *Porphyrellus*) as also exhibiting a dry pileus surface.

Recent studies of the type specimens of species of *Porphyrellus* (Wolfe, 1978) brought to light characters which indicated that *P. viscidus* McNabb (type species of sect. *Pseudotylopili*) was significantly different from *P. porphyrosporus* (Fr.) Gilbert. The character state differences were consistent in the trichodermium, pleurocystidia, and spores. The pileus cuticle of *P. viscidus* was an ixotrichodermium, not a palisade or interwoven trichodermium as in *P. porphyrosporus* . The pleurocystidia of *P. viscidus* are devoid of microchemically reactive contents, a character state not found in *P. porphyrosporus*. Even though the spore deposit color of *P. viscidus* was similar to that of *P. porphyrosporus*, the spore E^m values (length/width ratio) in *Pseudotylopili* and *Porphyrellus* were consistently dissimilar. In *Pseudotylopili* the E^m value was consistently greater than 3.0, whereas in *Porphyrellus* the E^m value was consistently less than 3.0 (Wolfe, 1978). The above characters exhibited by *P. viscidus* violate generic characters as exemplified by *P. porphyrosporus*. *Porphyrellus viscidus* must therefore be removed from *Porphyrellus*. Since *P.viscidus* violates circumscriptional characters of *Tylopilus* as well, it cannot be included in this genus. The character states exhibited by *P. viscidus* and thus sect. *Pseudotylopili* are such that it cannot be conveniently accomodated by any of the genera of the Boletaceae as summarized by Singer (1945, 1947, 1975), Snell & Dick (1970), and Smith & Thiers (1971). It therefore seems justified to recognize a new genus to accommodate those taxa formerly in *Porphyrellus* sect. *Pseudotylopili*.

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[1] Part of a dissertation submitted to the Graduate School of The University of Tennessee in partial fulfillment of the requirements of the Doctor of Philosophy degree.

The color names appearing in quotes are from Ridgway (1912); and the herbaria designations are from Holmgren & Keuken (1974). The term spores as used in this paper refers specifically to basidiospores. The following abbreviations were used for particular measurements: $\underline{D}^m$ = median dimensions; $\underline{d}^m$ = median diameter or width; $\underline{L}^m$ = median length; $\underline{E}$ = length width ratio; $\underline{E}^m$ = median length/width ratio.

Mucilopilus Wolfe, gen. nov.

≡ *Porphyrellus* sect. *Pseudotylopili* McNabb. 1967. N. Zealand J. Bot. 5: 546.

Pileus viscidus ad mucilaginosus vel siccus, glaber ad tomentosus; cuticula pilei ixotrichodermium. Contextum album, immutatum nocitum. Hymenophorum album immaturum, subcarneum vel violaceum maturatum. Pleurocystidia quandoque praesentia hyalina. Sporae subbrunneae, ferrugineae, ("Russet", "Roods Brown"), *longae, angustae,* E^m *(medium longitudinali/latitudinali proportione) idem vel majus quam 3.0. Species typica Porphyrellus viscidus* McNabb.

Pileus glabrous or floccose-tomentose, viscid to mucilaginous, or dry and scrobiculate; pileus cuticle an ixotrichodermium, in some taxa the gelatin accumulating irregularly among hyphae. Context white to sordid white to brown-white; unchanging on injury; changing or unchanging in KOH. Hymenophore pallid to sordid white young to pallid gray-red, pink, pallid violet at maturity. Tube mouths small (0.25 mm - 1.00 mm diam.), irregularly angular; tubes 5 - 8 mm long; tubes and pores concolorous and unchanging on injury. Stipe equal to tapering above, glabrous, subglabrous, finely velutinate to subpruinose, rarely reticulate, felty; annulus absent. Spore print ferruginous to light brown to "Russet". Spores smooth, subfusiform, E^m 3.0 - 3.5. Pleurocystidia (when present) fusoid-ventricose to lanceolate, rarely 1-septate, void of microchemically reactive contents. Cheilocystidia (when present) equal to subclavate to clavate. Hymenophoral trama bilateral-divergent. Clamp connections absent. Mycorrhizal with Pinaceae and Fagales.

Observations. Taxa of *Mucilopilus* possess similar character states: the pileus cuticle, tube mouths, spore E^m values, and cystidial characters. They are significantly different from those of the type species of *Tylopilus* and *Porphyrellus*. However, taxa of *Tylopilus*, *Porphyrellus*, and *Mucilopilus* share a similar spore print color range: pink-flesh to brown to purple brown. The pileus cuticle of the type species of *Mucilopilus* is an ixotrichodermium, while the pileus cuticle of the type species of *Tylopilus* and *Porphyrellus* is a palisade to interwoven trichodermium and has not been reported to gelatinize. The tube mouths of the type species of *Mucilopilus*, though small, do not discolor on injury, but the tube mouths of the type species of both *Tylopilus* and *Porphyrellus* (with small and large tube mouths respectively) do so. The spore E^m value of the type species of *Mucilopilus* is consistently greater than 3.0, but in *Porphyrellus* the spore E^m value of the type species is consistently less than 3.0. Spore dimensions of the type species of *Mucilopilus* appear to be similar to those reported for the type species of *Tylopilus* although the E^m values for spores of *Tylopilus* are not known. Pleurocystidia of the type species of *Mucilopilus* are void of microchemically reactive contents and are hyaline. In *Tylopilus* and *Porphyrellus* the type species of each genus have pleurocystidia which have colored contents and are microchemically reactive.

It should be pointed out that *Mucilopilus* has some similarities with taxa of *Suillus*, e.g. the presence of an ixotrichodermium and a mycorrhizal association with Pinaceae (and also Fagales in *Mucilopilus* and one species of *Suillus*). However, spore and pleurocystidial characters are sufficiently different to maintain the generic separation.

The recognition of *Mucilopilus* as a new genus of the Boletaceae was based on the infrataxic character state similarities and intergeneric dissimilarities with *Tylopilus* and *Porphyrellus*. I have hesitated in recognizing this new genus of the Boletaceae because of the great emphasis which historically has been placed on spore print color as a major character of generic importance in the fleshy fungi. Fries (1821) placed great value on spore print color in the fleshy fungi (as well he should have, given the level of technology in his day). Karsten (1881), Quélet (1886), Snell & Dick (1970), Smith & Thiers (1971), Grund & Harrison (1976), Thiers (1975), and, to a lesser extent, Singer (1945, 1947, 1951, 1962, 1967, 1975) also used spore print color as a major unifying generic character state in the boletes. Corner (1972) opined that spore print color was highly variable and thus only of value at the subgenus rank. I have found in these studies character states other than spore print color which unite taxa into natural groups dissimilar from other genera of boletes. It is apparent that the generic value of spore print color may not be necessarily the most natural character state useful in establishing generic concepts.

Key to the Sections

1'. Pileus dry, scrobiculate . . . . *Scrobiculati*

1". Pileus viscid to mucilaginous . . . . *Mucilopilus* (no North American representatives).

Section *Scrobiculati* (Singer) Wolfe, comb. nov.
Basionym: *Tylopilus* sect. *Scrobiculati* Singer. 1947.
Amer. Midl. Naturalist 37: 95.
≡ *Porphyrellus* sect. *Scrobiculati* (Singer) Singer. 1975.
Agaricales in Modern Taxonomy p.748.

Type species: *Boletus conicus* Ravenel *apud* Berkley & Curtis

Similar to type section. Pileus floccose, scrobiculate, dry; pileus cuticle an ixotrichodermium below an interwoven trichodermium. Context white, unchanging on injury; yellow in KOH.

Observations. The decision to include sect. *Scrobiculati* in *Mucilopilus* was not immediately obvious. Wolfe & Petersen (1978) published photomicrographs of the cuticle of *B. conicus* (only species of sect. *Scrobiculati*) which demonstrated the gelatinizing nature of the pileus cuticle. The ixotrichodermium, smooth spores with an E^m value exceeding 3.0, and the hyaline pleurocystidia clearly indicate that *B.conicus* (and thus sect. *Scrobiculati*) clearly belongs in *Mucilopilus*.

Key to North American Taxa

1'. Stipe surface felty to tomentose . . . .1a. *M. conicus* var.*conicus*

1". Stipe surface reticulate . . . . . 1b. *M. conicus* var. *reticulatus*

1. *Mucilopilus conicus* (Rav. apud B. & C.) Wolfe, comb. nov.
Basionym: *Boletus conicus* Ravenel *apud* Berkley & Curtis. 1853.
Ann. Mag. Nat. Hist. 12: 430.

Type specimen (holotype):FH - "(2929); *Boletus conicus* Rav. (!); ad terram humidi in Pinetis, Julio 1849; Santee Canal, S.C.; Ravenel (1024)" [!]

Pileus 2.5 - 10 x 1 - 2 cm, convex to plano-conves, surface of comples ridges and excavated pits (scrobiculate); ridges "Sudan Brown", "Raw Sienna", "Yellow Ocher", "Mustard Yellow", "Buffy Brown", "Wood Brown"; the pitted areas pale yellow to white, near the margins "Cream Buff" to "Light Buff"; fibrillose, fasciculate and adpressed; dry. Context to 1 cm thick at disc, white, odor and taste mild. Pores 1.5 - 2 per mm, equal, "Pale Grayish Vinaceous", Pale Vinaceous Fawn", unchanging on injury. Stipe 4 - 7 x 0.6 - 1.5 cm, equal, tapering basally to a point, ventricose, white apically and basally, pale yellow to "Light Pinkish Cinnamon", "Chamois", short felty to reticulate over upper half. Spore print "Roods Brown".

Pileus cuticle an ixotrichodermium; terminal cells 2.5 - 6.5 (-11.5) µm diam. ($\underline{d}^m$ = 4 µm), hyaline in KOH, pale yellow in Melzer's. Tube trama hyphae 2.5 - 10.5 (-11.5) µm diam. ($\underline{d}^m$ = 5 µm), boletoid, gelatinous to subgelatinous, hyaline in KOH, pale yellow in Melzer's. Clamp connections absent.

Basidia 19.5 - 44 x 6.5 - 14.5 µm ($\underline{D}^m$ = 32.5 x 9 µm), thin-walled, clavate, 2 - 4 sterigmate, hyaline and reviving poorly in KOH, pale yellow in Melzer's. Pleurocystidia 28 - 58.5 x 5 - 10.5 µm ($\underline{D}^m$ = 45.5 x 6.5 µm), thin-walled, subventricose to broadly lanceolate, hyaline in KOH,pale yellow and non-reactive in Melzer's, rare, occasionally with a distal secondary septum; cheilocystidia absent; caulocystidia 15.5 - 23.5 x 4.5 - 7 µm ($\underline{D}^m$ = 20 x 5.5 µm), clavate, hyaline in KOH, yellow in Melzer's, rare and inconspicuous.

Spores 12.5 - 18 (-21) x 4 - 6.5 µm ($\underline{D}^m$ = 15.5 x 5 µm; $\underline{E}$ = 2.5 -

4.3 (-4.7); $E^m = 3.2$), narrowly elliptical to elliptical, inequilateral by a broad suprahilar depression and adaxial swelling, pale yellow-cinnamon in Melzer's; surface smooth, walls continuous, surrounded by a hyaline membrane.

Macrochemistry (*per* Singer, 1947). Pileus surface: KOH - darker than normal then brown; NH_4OH - darker than normal then brown. Context: KOH - yellow then brown; NH_4OH - negative; Formal - negative. Pores: H_2SO_4 - negative. Tubes: $FeSO_4$ - steel gray.

Habitat and Distribution: Sandy, moist soil under *Pinus sp.*, *Pinus palustris,* and *Pinus taeda;* United States coastal plain from South Carolina to Florida; mycorrhizal affinities unknown.

Observations. This is the only species of the section *Scrobiculati* known to have a floccose, tomentose, and pitted (scrobiculate) pileus surface. Its characters at the microscopic level are the same as the section.

1a. *Mucilopilus conicus* var. *conicus* (Rav. *apud* B. & C.) Wolfe. 1979. This paper p. 119.

≡ *Boletus conicus* Ravenel *apud* Berkley & Curtis. 1853. Ann. Mag. Nat. Hist. 12: 430.

≡ *Suillus conicus* (Rav. *apud* B. & C.) Kuntze. 1898. Rev. Gen. Pl. 3(2): 535.

≡ *Tylopilus conicus* (Rav. *apud* B. & C.) Beardslee. 1934. Mycologia 26: 253.

≡ *Porphyrellus conicus* (Rav. *apud* B. & C.) Singer. 1975. Agaricales in Modern Taxonomy, 3d ed., p. 748.

[≡ *Ceriomyces conicus* (Rav. *apud* B. & C.) Murrill. 1909. Mycologia 1: 146. nom. illeg.]

Macroscopic characters same as species, but stipe smooth, not reticulate. Macrochemistry same as species.

Microscopic characters vary somewhat between the varieties so they will be presented in detail.

Pileus cuticle an ixotrichodermium; terminal cells 2.5 - 8 (-11.5) µm diam. ($d^m = 4$ µm), hyaline in KOH, pale yellow in Melzer's. Tube trama hyphae 2.5 - 11.5 µm diam. ($d^m = 5$ µm), boletoid, gelatinous to subgelatinous, hyaline in KOH, pale yellow in Melzers. Clamp connections absent.

Basidia 19.5 - 44 x 6.5 - 14.5 µm ($D^m = 30 \times 9$ µm), thin-walled, clavate, 2 - 4 sterigmate, hyaline and reviving poorly in KOH, pale yellow in Melzer's. Pleurocystidia 28 - 58.5 x 5 - 6.5 µm ($D^m = 45.5 \times 5$ µm), subventricose to broadly lanceolate, hyaline in KOH, pale yellow in Melzer's, rare, occasionally with a distal secondary septum; cheilocystidia 15 - 23.5 x 5 - 6.5 µm ($D^m = 19.5 \times 5$ µm), clavate, hyaline in KOH, yellow in Melzer's, rare and inconspicuous.

Spores 12.5 - 18 x 4 - 6 µm ($D^m = 15.5 \times 5$ µm; $E = 2.16 - 3.6$; E^m =

3.0), narrowly elliptical to elliptical, inequilateral by a broad suprahilar depression and adaxial swelling, pale cream khaki in KOH, pale yellow cinnamon in Melzer's; surface smooth, walls continuous, surrounded by a hyaline membrane.

Habitat and Distribution: Solitary, under *Pinus* sp. and *Pinus palustris;* coastal plain, South Carolina and Florida.

Observations. This variety differs from the species only slightly in sizes of some characters. The stipe is smooth and not prominently reticulate

Specimens Examined

United States

South Carolina: Santee Canal, S.C., ad terram humidi in Pinetis, Julio 1849, Ravenel (1024), Curtis (2929), HOLOTYPE, (FH).

Florida: 1 mi. east of Gainesville, Flatwood under *Pinus palustris,* vii. 1943, R. Singer, (FH no. F2780).

1b. Mucilopilus conicus var. *reticulatus* Wolfe, var. nov.

A typus differt: stipes reticulatus. Holotypus: BPI - Prope Highlands Hammock, Florida; V.K. Charles, 13.xii.1938.

Pileus 2 - 6.5 x 1 - 2 cm, convex, tomentose to fibrillose, scrobiculate, pitted, "Buffy Brown" to "Wood Brown" near the margins "Cream Buff". Tubes and pores concolorous; tubes to 1.5 cm long, "Buckthorn Brown", to "Wood Brown" to "Cinnamon"; pores small to 1 mm diam. Stipe 4.5 - 8.5 x 0.7 - 0.8 cm, subobclavate to obclavate, reticulate over upper half broadly so; base pallid cream, mycelial.

Pileus cuticle an ixotrichodermium; terminal cells 2.5 - 6.5 µm diam. ($\underline{d}^{m}$ = 4 µm), hyaline in KOH, pale yellow in Melzer's. Tube trama hyphae 2.5 - 8 (-10.5) µm diam ($\underline{d}^{m}$ = 5 µm), boletoid, hyaline in KOH, yellow in Melzer's. Clamp connections absent.

Basidia 26 - 40.5 x 6.5 - 9 µm ($\underline{D}^{m}$ = 35 x 8 µm), thin-walled, subclavate to subequal, sinuous, 2 - 4 sterigmate, hyaline in KOH, pale yellow in Melzer's. Pleurocystidia 32.5 - 58 x 6.5 - 10.5 µm ($\underline{D}^{m}$ = 45.5 x 9 µm), thin-walled, narrowly fusoid-ventricose to broadly lanceolate, occasionally 1-septate, hyaline and with refractile inclusions occasionally in KOH, pale yellow in Melzer's, rare; cheilocystidia not observed; caulocystidia 16 - 23 x 4.5 - 6 µm ($\underline{D}^{m}$ = 21 x 6 µm), thin-walled, clavate, hyaline in KOH, yellow in Melzer's, infrequent.

Spores 13 - 21 x 4 - 5 (-6.5) µm ($\underline{D}^{m}$ = 15.5 x 5 µm; $\underline{E}$ = 2.5 - 4.7; $\underline{E}^{m}$= 3.3), narrowly elliptical, inequilateral by a shallow suprahilar depression and adaxial swelling, pale yellow green in KOH, cinnamon to pale rust (subdextrinoid to dextrinoid) in Melzer's; surface smooth, inner walls cinnamon in KOH, outer wall dark brown in KOH, walls continuous, surrounded by a hyaline membrane.

Macrochemistry: unknown.

Habitat and Distribution: Solitary to gregarious, under *Pinus taeda;* Florida.

Observations. *Mucilopilus conicus* var.*reticulatus* differs only slightly from the species and var. *conicus* in minor size variations of a few taxonomic characters. The stipe in var. *reticulatus* as the name implies is prominently reticulate over the central and upper regions.

Specimens Examined

United States

Florida: Highlands Hammock, 13.xii.1938, V.K. Charles, HOLOTYPE, (BPI); Newnan's Lake, under Pinus Taeda, 24.vi.1930, coll, Bratley and West, (FLAS no. F8976).

Type Studies

Studies of type specimens of the various taxa included in *Mucilopilus* are necessary for several reasons. They provide a basis for understanding the relationships between the North American taxa and those reported for the world. They provide data which in some cases is not available in the literature. Type studies can also indicate the relative position of the type within species parameters. These studies help clarify taxonomic concepts and provide stability in both taxonomy and nomenclature. Type studies may provide data which may require a type specimen status change. Finally, type studies offer the opportunity to clarify and establish new taxonomic concepts of taxa previously poorly understood.

The various type descriptions are arranged alphabetically by the first letter of the last epithet, specific or varietal.

Key to the Type Specimens

1'. Pileus surface floccose, pitted (scrobiculate), dry . . . . 2'

1". Pileus surface glabrous, mucilaginous, glutinous, or viscid . . . 3'

2'. Stipe felty to tomentose . . . . *B. conicus* var. *conicus*

2". Stipe reticulate . . . . *M. conicus* var. *reticulatus*

3'. Spore L^m > 17 μm . . . . *P. viscidus* var. *macrosporus*

3". Spore L^m 17 μm or less . . . . 4'

4'. Pleurocystidia absent . . . . *P. nothofagi*

4". Pleurocystidia present . . . . 5'

5'. Pleurocystidia L^m > 75 μm . . . . *T. venezuelae*

5". Pleurocystidia L^m < 60 μm . . . . 6'

6'. Hymenophore pallid-flesh at maturity . . . . *P. viscidus*

6". Hymenophore pallid-violet at maturity . . . . *B. violaceiporus*

Boletus conicus Ravenel *apud* Berkley & Curtis. 1853. Ann. Mag. Nat. Hist. 12: 430.

Type specimen (holotype): FH - "(2929); *Boletus conicus* (Rav.) (!); ad terram humidi in Pinetis, Julio 1849; Santee Canal, S.C., Ravenel (1024)." [!]

Fruitbody one and a pileus of a second, glued to paper with fresh collection notes by Ravenel. Pileus 2 x 0.2 cm; surface uneven by small depressions and short elevations, fascicles of short tomentum. Stipe 2 x 0.3 cm, equal, glabrous. Hymenium appears to have been depressed about stipe.

Pileus cuticle an interwoven to repent ixotrichodermium with gelatin accumulating irregularly; terminal cells indeterminable, cuticular cells 2.5 - 11.5 µm diam. ($\underline{d}^m$ = 4 µm), hyaline in KOH, pale yellow in Melzer's. Tube trama hyphae 2.5 - 6.5 µm diam. ($\underline{d}^m$ = 4 µm), bilateral, parallel to subdivergent, hyaline in KOH, pale yellow in Melzer's, gelatinized and barely discernible. Clamp connections absent.

Basidia 19.5 - 30 (-39) x 6.5 - 10.5 µm ($\underline{D}^m$ = 26 x 9 µm), thin-walled, clavate, hyaline and reviving poorly in KOH, pale yellow in Melzer's (Fig. 1). Pleurocystidia 28 - 45.5 x 5 - 6.5 µm ($\underline{D}^m$ = 45.5 x 6.5 µm), subventricose to broadly lanceolate, hyaline in KOH, pale yellow in Melzer's, occasionally with a distal secondary septum, rare (Fig. 2); cheilocystidia and caulocystidia absent.

Spores 12.5 - 18 x 4 - 6 µm ($\underline{D}^m$ = 15.5 x 5 µm; $\underline{E}$ = 2.2 - 3.6; $\underline{E}^m$ = 3.0), elliptical to narrowly elliptical, inequilateral by a suprahilar depression and adaxial swelling, pale yellow, cream khaki with 1 - 3 guttules in KOH, pale yellow cinnamon in Melzer's; surface smooth, walls continuous, surrounded by a hyaline membrane (Fig. 3); in deposit "Roods Brown".

Observations. SEM photos of the spores of this specimen were published by Wolfe & Petersen (1978), demonstrating the smooth spore surface. Photomicrographs of the pileus cuticle were also presented (Wolfe & Petersen, 1978), showing for the first time that the pileus cuticle was an ixotrichodermium. The tube trama hyphae of the type specimen were found to be parallel to inconspicuously subdivergent and gelatinized to some degree. This does not, however, occur in the species *M. conicus*, which has the boletoid arrangement of the tube trama hyphae. One explanation of this descrepancy could be that the tissues did not revive well in 10% KOH. The specimen could have been old when collected and the gelatinized nature of the walls could have given the tube trama hyphae their parallel appearance.

Porphyrellus viscidus var. *macrosporus* McNabb. 1967. New Zealand J. Bot. 5(4): 546.

Type specimen (holotype): PDD - "25186; solitary under *Leptospermum ericoides;* Auckland; Waitakere Filters; 25.v.1966; R.F.R McNabb." [!]

Fruitbody one. Pileus 3 x 0.3 cm, surface glabrous, smooth, uninterrupted, appears to have been viscid when fresh, vinaceous brown, pores gelatinized. Stipe 5 x 0.7 cm, obclavate, yellow-tan to khaki with minute pruina scattered over the surface.

Pileus cuticle an interwoven ixotrichodermium; terminal cells 2.5 - 5 μm diam. ($\underline{d}^m$ = 4 μm), equal, hyaline in KOH, yellow in Melzer's. Tube trama hyphae 4 - 6.5 μm diam. ($\underline{d}^m$ = 5 μm), boletoid, hyaline in KOH, yellow in Melzer's, some appearing subgelatinous. Clamp connections absent.

Basidia 32.5 - 41.5 x 8 - 10.5 μm ($\underline{D}^m$ = 35 x 9 μm), thin-walled, clavate, 2 - 4 sterigmate, hyaline in KOH, yellow in Melzer's (Fig. 4). Pleurocystidia 43 - 53.5 x 9 - 12 μm ($\underline{D}^m$ = 52 x 9 μm), thin-walled, fusoid-ventricose, hyaline in KOH, yellos in Melzers, rare; cheilocystidia 54.4 - 93.5 x 5 - 8 μm ($\underline{D}^m$ = 65 x 6.5 μm), thin-walled, subclavate to equal, occasionally with a secondary septum, hyaline in KOH, yellow in Melzer's (Fig. 5); caulocystidia 23.5 - 78 x 6.5 - 9 μm ($\underline{D}^m$ = 39 x 8 μm), thin-walled, equal to obclavate, fasciculate, opaque cream in KOH, yellow in Melzer's, occasionally with a recurved distal end.

Spores 15.5 - 24.5 x 4 - 8 μm ($\underline{D}^m$ = 19.5 x 5 μm; $\underline{E}$ = 3 - 4.8; $\underline{E}^m$ = 3.8), elliptical to narrowly elliptical, inequilateral by a narrow suprahilar depression and adaxial swelling, yellow-khaki with green refractile contents in KOH, yellow to yellow-rust (dextrinoid) in Melzer's (Fig. 6); surface smooth (Fig. 19), inner distal wall discontinuity, surrounded by a hyaline membrane; in deposit "Russet", light brown.

Observations. This specimen is very similar to *P. viscidus* var. *viscidus* McNabb by the presence of the ixotrichodermium, basidial and cystidial characters. Spores of this specimen are longer by 5 m (at the upper range limit) and by 2.5 m at the $\underline{L}^m$ value that var. *viscidus*. The spore $\underline{E}^m$ value is also greater than that of var. *viscidus* by 0.3. The spore character differences appear to be sufficiently different for varietal recognition. More studies of general collections will be necessary for confirmation of this conclusion. Because this taxon belongs in the genus *Mucilopilus* the following new combination is proposed.

Mucilopilus viscidus var. *macrosporus* (McNabb) Wolfe, comb. nov.
Basionym: *Porphyrellus viscidus* var. *macrosporus* McNabb.
1967. New Zealand J. Bot. 5: 546.

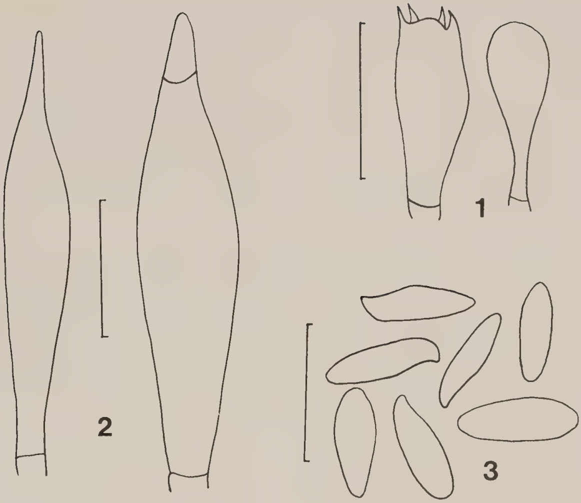
Porphyrellus nothofagi McNabb. 1967. New Zealand J. Bot. 5(4): 543.

Type specimen (holotype):PDD - "25184; on groung under *Nothofagus menziesii;* Otago District, Catlins, Puketiro Reserve; 29.iii.1966; coll and det. R.F.R. McNabb." [!]

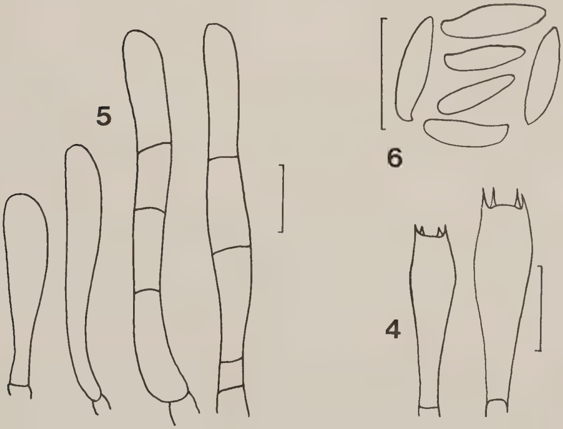
Fruitbodies two. Pilei 2 - 3.5 x 0.3 - 0.5 cm, smooth, uninterrupted, light gold. Stipe 5 - 5.2 x 0.2 - 0.4 cm, equal to subobclavate, concolorous with pileus, smooth.

Pileus cuticle an interwoven ixotrichodermium; terminal cells 2.5 - 6.5 μm diam. ($\underline{d}^m$ = 4 μm), hyaline in KOH, yellow in Melzer's. Tube trama hyphae 2.5 - 8 μm diam. ($\underline{d}^m$ = 8 μm), boletoid, hyaline in KOH, yellow in Melzer's. Clamp connections absent.

Basidia 30 - 43 x 10.5 - 13 μm ($\underline{D}^m$ = 32.5 x 11.5 μm), thin-walled, clavate, hyaline in KOH, yellow in Melzer's. Pleurocystidia absent; cheilocystidia 19.5 - 47 x 4 - 8 μm ($\underline{D}^m$ = 34 x 6.5 μm), thin-walled with



Figures 1 - 3. *Boletus conicus* (holotype). Fig. 1. Basidia, mature and immature. Fig. 2. Pleurocystidia. Fig. 3. Basidiospores. Standard line = 20 µm.



Figures 4 - 6. *Porphyrellus viscidus* var. *macrosporus* (holotype). Fig. 4. Basidia. Fig. 5. Cheilocystidia. Fig. 6. Basidiospores. Standard line = 20 µm.

a few becoming thick-walled, equal, hyaline in KOH, yellow in Melzer's, abundant (Fig. 7); caulocystidia 26 - 39 x 5 - 9 μm ($\underline{D}^m$ = 31 x 8 μm), thin-walled, equal to clavate, hyaline to pale yellow in KOH, yellow in Melzer's.

Spores 14 - 19.5 x 4 - 5 μm ($\underline{D}^m$ = 17 x 5 m; $\underline{E}$ = 2.8 - 5.0; $\underline{E}^m$ = 3.5), elliptical to subfusiform, inequilateral by a shallow suprahilar depression and adaxial swelling, pale yellow-cinnamon with green refractile inclusions in KOH, yellow-rust (pale dextrinoid) in Melzer's; surface smooth, walls continuous, surrounded by a hyaline membrane (Fig. 8); in deposit "Russet", light brown.

Observations. The ixotrichodermium of the pileus, the equal cheilocystidia, and the long, narrow spores ($\underline{E}^m$ = 3.5) clearly indicate this specimen as being very similar to *B. conicus*, *T. venezuelae*, *B. violaceiporus*, and *P. viscidus;* this taxon differs from the other taxa in this genus by the absence of pleurocystidia. Because this taxon belongs in the genus *Mucilopilus*, the following new combination is proposed.

Mucilopilus nothofagi (McNabb) Wolfe, comb. nov.
Basionym: *Porphyrellus nothofagi* McNabb. 1967. New Zealand J. Bot. 5(4): 543.

Mucilopilus conicus var. *reticulatus* Wolfe. This paper p. 121.

Type specimen (holotype): BPI - "Highlands Hammock, Florida; 13.Dec. 1938; V.K. Charles." [!]

Fruitbody one. Pileus 6.5 x 2 cm, fibrillose to tomentose, "Cream Buff" to "Light Buff", tomentum "Ochraceous Buff". Hymenophore "Buckthorn Brown", "Wood Brown", "Cinnamon". Stipe 8.5 x 0.7 cm, concolorous with pileus, subobclavate to obclavate; base pallid cream to white, mycelial.

Pileus cuticle an interwoven ixotrichodermium with gelatin accumulating irregularly; terminal cells not determinable, cuticular cells 2.5 - 6.5 μm diam. ($\underline{d}^m$ = 4 μm), hyaline in KOH, pale yellow to dextrinoid in Melzer's. Tube trama hyphae 2.5 - 10.5 μm diam. ($\underline{d}^m$ = 5 μm), parallel to subdivergent to bilateral, hyaline in KOH, yellow in Melzer's, gelatinous to subgelatinous. Clamp connections not observed.

Basidia 34 - 40.5 x 6.5 - 9 μm ($\underline{D}^m$ = 39 x 8 μm), thin-walled, subclavate to subequal, sinuous, mostly equal to subequal, hyaline in KOH, yellow in Melzer's. Pleurocystidia 40.5 - 58.5 x 6.5 - 10.5 μm ($\underline{D}^m$ = 49.5 x 8.5 μm), thin-walled, fusoid-ventricose, occasionally 1-septate, hyaline in KOH, yellow in Melzer's, occasionally with refractile inclusion; cheilocystidia not observed; caulocystidia 16 - 23 x 4.5 - 6 μm ($\underline{D}^m$ = 20 x 5.5 μm), thin-walled, clavate, hyaline in KOH, yellow in Melzer's, infrequent.

Spores 13 - 21 x 4 - 6.5 μm ($\underline{D}^m$ = 15.5 x 5 μm; $\underline{E}$ = 2.5 - 4.0; $\underline{E}^m$ = 3.2), elliptical to narrowly elliptical, inequilateral by a suprahilar depression and adaxial swelling, pale yellow, cream khaki with 1 - 3 green refractile guttules in KOH, yellow cinnamon in Melzer's; surface smooth, walls continuous, outer wall brown in Melzer's, surrounded by a hyaline membrane; in deposit "Rood's Brown".

Observations. This specimen is very similar to the type specimen of var. *conicus*, but shows a prominently reticulated stipe surface. The spore $\underline{E}^m$ value is 3.2 in this specimen as compared to 3.0 in the type specimen of var. *conicus*. The basidial $\underline{L}^m$ is 13 µm longer in the type of var. *reticulatus* than in the type of var. *conicus*. The characters of these two specimens are otherwise nearly identical

Tylopilus venezuelae Singer *et* Digilio. 1960. Lilloa 30: 163.
≡ *Porphyrellus venezuelae* (Singer et Digilio) Singer. 1970. Flora Neotropica Monograph 5: 19.

Type specimen (holotype): K - "Flora of Venezuelae; no. 1001; 1300m., Los Guayabitos, Est. Miranda; in Jorsted ravine; Coll., R.W.G. Dennis & Goldas; 8.6.'58." [!]

Fruitbody one half. Pileus 1.8 x 0.8 cm, surface glabrous, uninterrupted, light yellow-brown. Hymenium pale yellow-brown. Stipe 3 x 0.3 cm, equal, pale yellow-brown, becoming darker brown.

Pileus cuticle an appressed ixotrichodermium; terminal cells not discernible, cuticular cells 5 - 10.5 µm diam. ($\underline{d}^m$ = 6.5 µm), hyaline in KOH, yellow in Melzer's. Tube trama hyphae 4 - 10.5 µm diam. ($\underline{d}^m$ = 6.5 µm), boletoid, hyaline in KOH, yellow in Melzer's; gelatinous. Clamp connections absent.

Basidia 26 - 36.5 x 9 - 11 µm ($\underline{D}^m$ = 27.5 x 9 µm), thin-walled, clavate to narrowly clavate, some centrally constricted, 2 - 4 sterigmate, hyaline in KOH, yellow in Melzer's (Fig. 9). Pleurocystidia 63.5 - 93.5 x 9 - 13 (-18) µm ($\underline{D}^m$ = 80.5 x 11 µm), thin-walled to moderately thick-walled, fusoid-ventricose to broadly lanceolate, the ventricose portion located in the proximal portion of the cystidium, hyaline in KOH, yellow in Melzer's, frequent (Fig. 10); cheilocystidia absent; caulocystidia absent, but stipe surface appears to have been viscid.

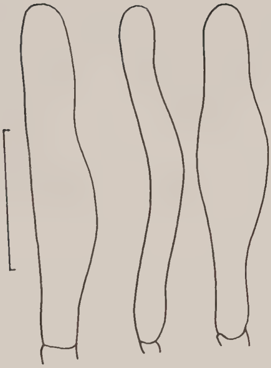
Spores 14 - 18.5 x 4.5 - 5.5 µm ($\underline{D}^m$ = 16 x 5 µm; $\underline{E}$ = 2.5 - 3.6; $\underline{E}^m$ = 3.4), narrowly elliptical, inequilateral by a narrow suprahilar depression and adaxial swelling, pale yellow-tan with green highlights in KOH, pale ochraceous cinnamon in Melzer's (Fig. 11); surface smooth (Fig. 20), walls continuous, surrounded by a hyaline membrane.

Observations. This specimen has somewhat unusual pleurocystidia; the ventricose portion of the cystidium is located in the proximal region rather than the usual central region. Moreover, the pleurocystidia are unusually long (about 80 µm). Because this taxon belongs in the genus *Mucilopilus* the following new combination is proposed.

Mucilopilus venezuelae (Singer et Digilio) Wolfe, comb. nov.
Basionym: *Tylopilus venezuelae* Singer et Digilio. 1960. Lilloa 30: 163.

Boletellus violaceiporus Stevenson. 1962. Kew Bull. 15(3): 384.
≡ *Porphyrellus violaceiporus* (Stevenson) McNabb. 1967. New Zealand J. Bot. 5(4): 543.

Type specimen (holotype): K - "Herb. Hort. Bot. Reg. Kew; Maitai,



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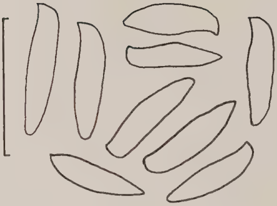

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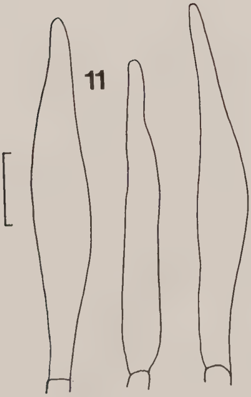

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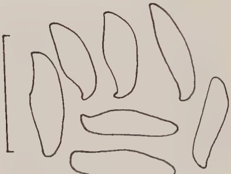

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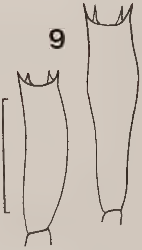

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Figures 7 - 8. *Porphyrellus nothofagi* (holotype). Fig. 7. Cheilocystidia. Fig. 8. Basidiospores. Standard line = 20 µm.

Figures 9 - 11. *Tylopilus venezuelae* (holotype). Fig. 9. Basidia. Fig. 10. Pleurocystidia. Fig. 11. Basidiospores. Standard line = 20 µm.

New Zealand; G.B.C. 1060; 29.4.1956." [!]

Fruitbody one. Pileus 2 x 0.4 cm, light yellow-brown, continuous, glabrous. Hymenium rust-brown. Stipe 4 x 0.3 cm, equal, smooth.

Pileus cuticle a palisade ixotrichodermium; terminal cells 4 - 6.5 µm diam. ($\underline{d}^{m}$ = 6.5 µm), equal, hyaline in KOH, yellow in Melzer's. Tube trama hyphae 2.5 - 8 µm diam. ($\underline{d}^{m}$ = 5 µm), boletoid, hyaline in KOH, yellow in Melzer's. Clamp connections absent.

Basidia (19.5-) 26 - 34 x 8 - 10.5 µm ($\underline{D}^{m}$ = 30 x 9 µm), thin-walled, calvate to narrowly clavate to subequal, hyaline in KOH, yellow in Melzer's, some with a slight central constriction (Fig. 12). Pleurocystidia 52 - 65 x 13 - 17 µm ($\underline{D}^{m}$ = 58.5 x 13 µm), thin-walled, broadly fusoid-ventricose, hyaline in KOH, yellow in Melzer's, rare (Fig. 13); cheilocystidia 23.5 - 37.5 x 5 - 9 (-11.5) µm ($\underline{D}^{m}$ = 32.5 x 8 µm), thin-walled, equal to subventricose to clavate, hyaline in KOH, yellow in Melzer's, in chains of 2 - 3 cells (Fig. 14); caulocystidia (19.5-) 26 - 35 (-39) x 5 - 8 µm ($\underline{D}^{m}$ = 30 x 6.5 µm), thin-walled, clavate, yellow in KOH, gold in Melzer's, some with a thick refractile apex.

Spores 13 - 18 (-21) x 4 - 6.5 µm ($\underline{D}^{m}$ = 17 x 5 µm; $\underline{E}$ = 2.8 - 3.7; $\underline{E}^{m}$ = 3.2), fusoid, inequilateral by a distinct suprahilar depression and adaxial swelling, pale ochraceous green in KOH, pale yellow-rust (subdextrinoid) in Melzer's (Fig. 15); surface smooth (Fig. 21), walls continuous, surrounded by a hyaline membrane.

Observations. The violet pallid color of the hymenophore is characteristic of this taxon. Since it belongs in the genus *Mucilopilus*, the following new combination is proposed.

Mucilopilus violaceiporus (Stevenson) Wolfe, comb. nov.
Basionym: *Boletellus violaceiporus* Stevenson. 1962. Kew Bull. 15(3): 384.

Porphyrellus viscidus McNabb. 1967. New Zealand J. Bot. 5(4): 543.

Type specimen (holotype): PDD - "25185; scattered under *Leptospermum scoparium/ericoides;* Auckland, Kerikeri, Opito Bay; 16.v.1966; R.F.R. McNabb." [!]

Fruitbodies two. Pilei 0.8 - 3.0 x 0.3 - 0.5 cm, vinaceous brown to yellow-brown, glabrous, appears to have been viscid when fresh. Stipe 1.8 - 3 x 0.3 - 0.6 cm, obclavate, khaki overall, faintly reticulate at the apex only.

Pileus cuticle an interwoven ixotrichodermium; terminal cells 4 - 6.5 µm diam. ($\underline{d}^{m}$ = 4 µm), equal to subclavate, hyaline in KOH, yellow in Melzer's. Tube trama hyphae 4 - 9 µm diam. ($\underline{d}^{m}$ = 6.5 µm), hyaline in KOH, yellow in IKI. Clamp connections absent.

Basidia 23.5 - 36.5 x 9 - 13 µm ($\underline{D}^{m}$ = 28.5 x 10.5 µm), thin-walled, clavate, 2 - 4 sterigmate, hyaline in KOH, yellow in Melzer's. Pleurocystidia 43 - 58.5 x 8 - 9 µm ($\underline{D}^{m}$ = 56 x 9 µm), narrowly fusoid-ventricose, hyaline in KOH, yellow in Melzer's (Fig. 16); cheilocystidia 24.5 - 54.5 x 6.5 - 10.5 µm ($\underline{D}^{m}$ = 41.5 x 8 µm), equal to subclavate, hyaline to pale yellow-tan in KOH, yellow in Melzer's, with an occasional distal secondary septum, abundant and clustered around the pores (Fig. 17); caulocystidia 39 - 69 x 6.5 - 9 µm ($\underline{D}^m$ = 52 x 8 µm), equal to clavate, scattered, pale yellow in KOH, gold-brown to dingy brown in Melzer's.

Spores 14.5 - 19.5 x 4 - 5 (-6.5) µm ($\underline{D}^m$ = 17 x 5 µm; $\underline{E}$ = 2.4 - 4.6; $\underline{E}^m$ = 3.5), elliptical to fusiform, inequilateral by a broad shallow suprahilar depression and adaxial swelling, yellow green with cinnamon walls in KOH, rust-yellow in Melzer's (Fig. 18); surface smooth, with a small and obscure inner wall discontinuity, surrounded by a hyaline membrane; in deposit "Russet", light brown.

Observations. Wolfe & Petersen (1978) published SEM's of the spores of this specimen which show the spore surface as smooth. Furthermore, the hymenophore at maturity is pallid flesh color. Because this specimen is the type specimen of the type species of the genus *Mucilopilus*, the following new combination is proposed.

Mucilopilus viscidus (McNabb) Wolfe, comb. nov.
Basionym: *Porphyrellus viscidus* McNabb. 1967. New Zealand J. Bot. 5(4): 543.

Literature Cited

Corner, E.J.H. 1972. Boletus in Malaysia. Government Printing Office, Singapore. 263p. + 23 plates.

Fries, E.M. 1821. Systema Mycologicum Vol. 1. Lundae. 508p.

__________ and C.T. Hök. 1835. Boleti Fungorum Generis Illustratio. Upsala. 14p.

Gilbert, E. 1931. Les Bolets. Paris. 255p.

Grund, D.W. and K.A. Harrison. 1976. Nova Scotian Boletes. Biblioth. Mycol. 47: 283p. + 68 pl.

Holmgren, P.K. and W. Keuken. 1974. Index Herbariorum, Part I. The Herbaria of the World. Regnum Vegetabile 92: 387p.

Horak, E. 1968. Beitrage zur Kryptogamenflora der Schweiz. Komisionsverlags Bruckerei Buchler & Co. AG, Wabern-Bern. 741p.

Karsten, P.A. 1881. Enumeratio Boletinearum et Polyporearum Fennicarum systemate novo dispositarum. Rev. Mycol. 3:16.

McNabb, R.F.R. 1967. The Strobilomycetaceae of New Zealand. New Zealand J. Bot. 5: 532 - 547.

Quélet, L. 1886. Enchiridion Fungorum in Europa et Prasertim in Gallia vigentium, I - IV, 352p.

Ridgway, R. 1912. Color Standards and Nomenclature. Washington, D.C. 43p + 53 pl.

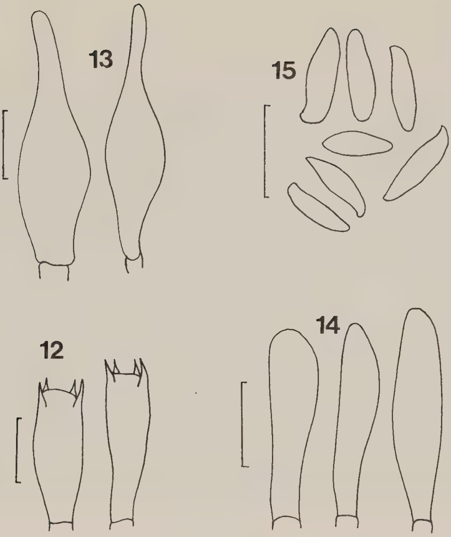
Singer, R. 1945. The Boletineae of Florida with notes on extralimital species. I. The Strobilomycetaceae. Farlowia 2: 97 - 141.

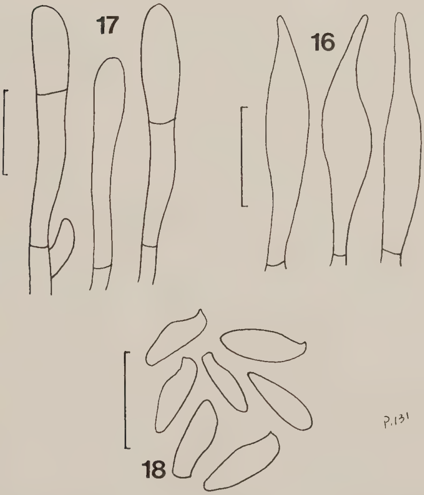
__________. 1947. The Boletineae of Florida with notes on extralimital species. III. The Boletoideae of Florida. Amer. Midl. Naturalist 37: 1 - 135.

__________. 1951. The Agaricales (Mushrooms) in Modern Taxonomy. Lilloa 22: 5 - 832 p.

__________. 1962. The Agaricales in Modern Taxonomy, 2d. ed. J. Cramer, Weinheim. 915p.

__________. 1967. Die Rohrlinge. Teil II. Die Boletoideae und Strobilomycetaceae. In Die Pilze Mitteleuropas 6: 1 - 151.





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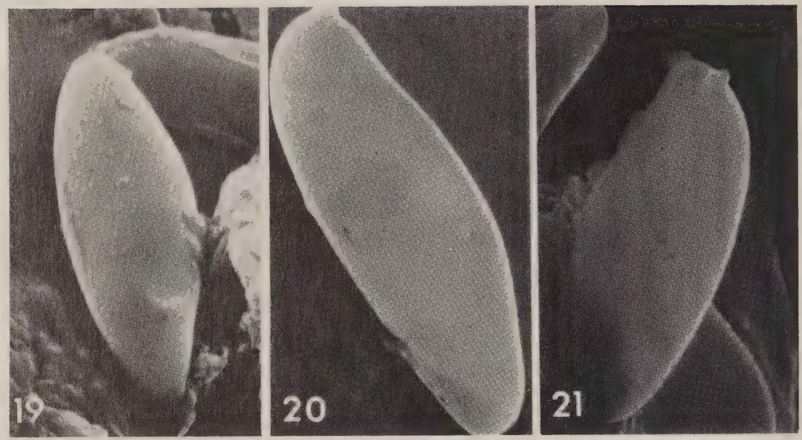
Figures 12 - 15. *Boletellus violaceiporus* (holotype). Fig. 12. Basidia. Fig. 13. Pleurocystidia. Fig. 14. Cheilocystidia. Fig. 15. Basidiospores. Standard line = 20 µm.

Figures 16 - 18. *Porphyrellus viscidus* (holotype). Fig. 16. Pleurocystidia. Fig. 17. Cheilocystidia. Fig. 18. Basidiospores. Standard line = 20 µm.



Figures 19 - 21. Scanning electron micrographs of basidiospores. Fig. 19. *Porphyrellus viscidus* var. *macrosporus*, 3960X. Fig. 20. *Tylopilus venezuelae*, 5960X. Fig. 21. *Boletellus violaceiporus*, 3960X.

Singer, R. 1975. The Agaricales in Modern Taxonomy, 3d ed. J. Cramer, Vaduz. 912 p.

Smith, A.H. and H.D. Thiers. 1971. The Boletes of Michigan. Univ. of Michigan Press, Ann Arbor. 427 p. + 157 pl.

Snell, W.H. and E.A. Dick. 1970. Boleti of Northeastern North America. J. Cramer, Lehre. 115p. + 87 pl.

Thiers, H.D. 1975. California Muchrooms. A field guide to the boletes. Hafner Press, New York. 261 p.

Wolfe, C.B. 1978. *Austroboletus* and *Tylopilus* subgenus *Porphyrellus*, with emphasis on North American taxa. Dissertation, (ined.), Univ. of Tennessee, Knoxville, vi. + 195p.

__________ and R.H. Petersen. 1978. Taxonomy and nomenclature of the supraspecific taxa of *Porphyrellus*. Mycotaxon 7: 152 - 162.

MYCOTAXON

Vol. X, No. 1 pp. 133-141 October-December 1979

RENISPORA FLAVISSIMA, A NEW GYMNOASCACEOUS FUNGUS WITH TUBERCULATE *CHRYSOSPORIUM* CONIDIA

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ABSTRACT

During a survey for *Ajellomyces capsulatus* (Kwon-Chung) McGinnis & Katz (1979) (= *Emmonsiella capsulata* Kwon-Chung) in south central Kansas, 66 isolates of a fungus microscopically resembling the *Chrysosporium* state of *A. capsulatus* were recovered from guano and soil in a barn housing a long-established colony of the bat *Myotis velifer*. Although the tuberculate conidia of these isolates were almost indistinguishable from those of *A. capsulatus*, cultures produced a bright yellow pigment and also remained mycelial at 37 C, instead of converting to the *Histoplasma* (yeast) state. This, and other differences, suggested that the barn isolates represented an undescribed species of *Chrysosporium*. Mating tests produced the perfect state which is described as a new genus of the Gymnoascaceae.

TAXONOMIC PART

Renispora Sigler et Carmichael, gen. nov.

Ascomycota, Gymnoascaceae.
Mycelium hyalinum. Gymnothecia globosa, parva, ex hyphis pallidis, intertextis, angustis, laevibus vel incrustatis composita. Asci pyriformes, evanescentis, octosporis. Ascosporae pallidae, ellipsoideae vel reniformes vel botuliformes, laeves vel subtiliter notatae.
Typus: *Renispora flavissima* Sigler, Gaur, Lichtwardt et Carmichael.

Renispora flavissima Sigler, Gaur, Lichtwardt et Carmichael, sp. nov.

Fungus heterothallicus est, cum characteribus generis. Gymnothecia 30-200um in diametro, flava, in mycelio aereo. Ascosporae (2.2) 2.5(3) x 4-5.5um, 0-septatae, frequenter biguttulatae, flavae, late ellipsoideae, reniformes vel quando exsicattae botuliformes, minute foveolatae. Status conidicus Chrysosporium Corda est. Conidia globosa, tuberculata, flava, 6-11(13)um in diametro. Typus: UAMH 4205, colonia exsiccata ex cruci UAMH 4140 x UAMH 4188, uterque ex solo et fimo, Kansas, U.S.A., 1976-1977.

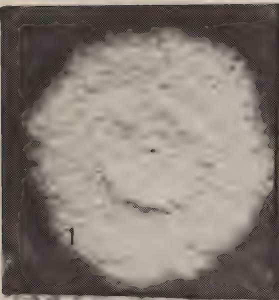
Description

After 28 days at 25 C colonies on cellophane on phytone yeast extract agar (Carmichael, 1962; Sigler and Carmichael, 1976) are 58-63 mm in diameter with an irregular lobate margin. The surface is powdery (Fig. 1) or velvety (Fig. 2), smoother and slightly raised at center, characteristically lemon-yellow with a dark gold reverse. Degenerate strains become pale yellow and floccose. At 37 C on cellophane, growth is greatly restricted (4-6 mm in 28 days), raised, dense, matted, buff, reverse brown. Without cellophane, growth is flatter.

On Pablum cereal agar on cellophane (Sigler and Carmichael, 1976), colonies (Figs. 3,4) are flat, powdery, dense or patchy, yellow with darker yellow surface growth, reverse gold. Aerial growth is sparser than on PYE and growth is slower (29-37 mm after 28 days).

Heterothallic. Gymnothecia (Fig. 5) yellow, spherical, small, 30-200um in diameter (mostly 100-150um), consisting of compactly intertwined, thin-walled, narrow, smooth or encrusted, hyaline or yellow hyphae, without distinct appendages. Peridial hyphae remain poorly differentiated from vegetative hyphae, and gymnothecia (Fig. 6) are surrounded by wefts of hyphae bearing conidia of the Chrysosporium state. Occasionally, hyphae within the gymnothecium break up to produce a few arthroconidia (Fig.

Figs. 1-14. Renispora flavissima. (1,3 - UAMH 4188; 2 - UAMH 4191; 4 - UAMH 4189; 5,6,11 - cross of 4189 x 4191; 7,8 - cross of UAMH 4187 x 4191; 9,14 - cross of UAMH 4140 x 4188; 10,12,13 - cross of UAMH 4184 x 4191). Figs. 1-4. Colonies on cellophane after 28 days at 25 C, x0.7. 1 and 2 on phytone yeast extract agar. 3 and 4 on cereal agar. Fig. 5. Gymnothecium composed of thin-walled, intertwined peridial hyphae, x600. Fig. 6. Gymnothecium on oatmeal agar plate viewed under low power of microscope. Gymnothecium surrounded by hyphae bearing Chrysosporium conidia, x150. Fig. 7. Arthroconidia found in vicinity of gymnothecium, x1680. Fig. 8. Ascomatal initial, x1680. Fig. 9. Clavate asci on short stalks, x1680. Figs. 10,11. Finely roughened, reniform or bacilliform ascospores, x1680. Figs. 12,13. Pitted or convoluted surface of ascospores viewed with an electron microscope. 12, x9200; 13, x23,500. Fig. 14. Region of scant growth between tester strains in cross of 4140 x 4188 on oatmeal agar after 41 days at 28 C, x0.7.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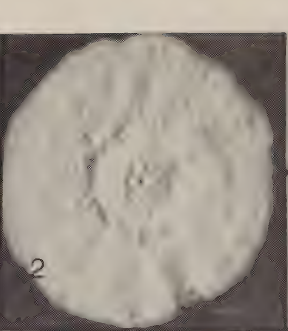
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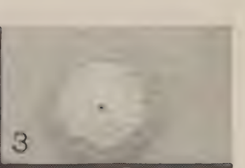
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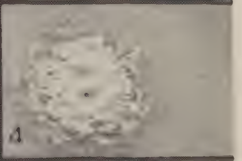
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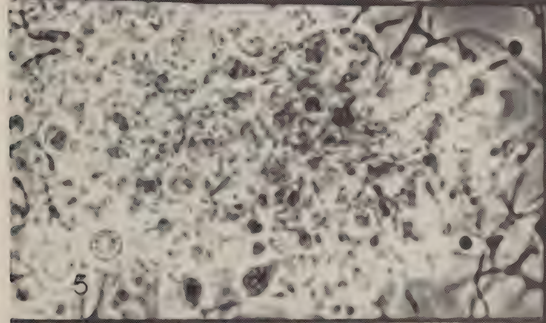
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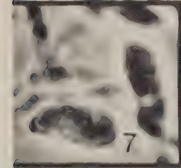
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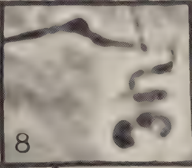
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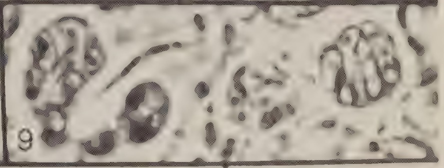
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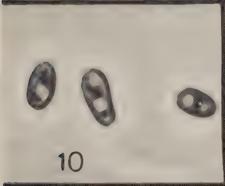
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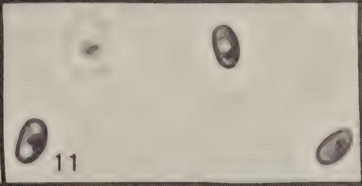
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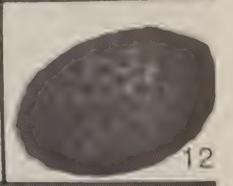
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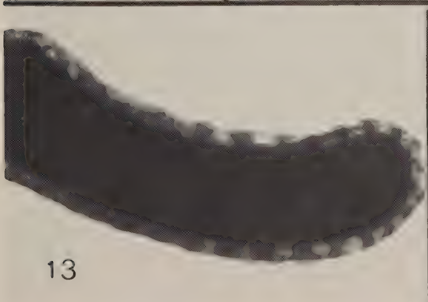
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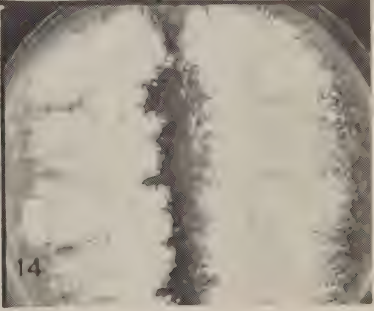
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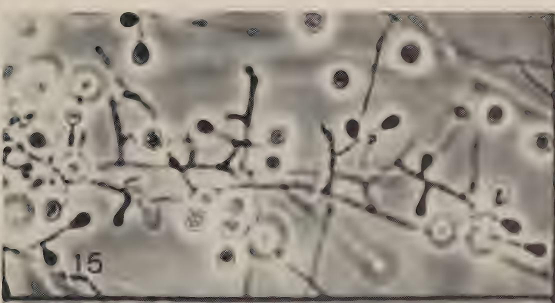
7). Ascomatal initials (Fig. 8) hyaline, consisting of two hyphae coiling about each other. Asci (Fig. 9) on short stalks, clavate, 8-spored, evanescent, hyaline (6 x 10um). Ascospores reniform or bacilliform, surface appearing finely roughened at high magnification on the light microscope (Figs. 10,11) and pitted or convoluted when the surface is viewed with an electron microscope (Figs. 12,13). They are hyaline, yellow at maturity, often having 1 or 2 lipid droplets, and measure (2.2-)2.5(-3) x 4-5.5um.

Aleurioconidia are borne terminally on short or long lateral branches or directly on the sides of the fertile hyphae (Figs. 15-18,20). Rarely, two or three conidia are formed in succession (Fig. 19) The conidiogenous or basal cell is unswollen. Aleurioconidia are initially ellipsoidal to pyriform, later becoming globose or subglobose, spiny (Figs. 15-18) or prominently tuberculate (Fig. 21), yellow, and measure 6-11(13)um in diameter. On potato dextrose agar, conidia measured 5.5-14(15.5)um. The tuberculations are usually less than .5um in length (Fig. 21) but may measure up to 1.8um (Fig. 22). No other conidia were observed in cultures of the conidial state. At 37 C, only mycelium is seen.

Holotype: The type of R. flavissima is a dried culture of UAMH 4140 x 4188 preserved in UAMH as 4205. Duplicates are deposited in the National Mycological Herbarium, Ottawa, Canada and the Commonwealth Mycological Institute, Kew, England. Subcultures of the + (UAMH 4140) and - (UAMH 4188) mating types are deposited in CMI, The American Type Culture Collection, and the Centraalbureau voor Schimmelcultures.

Habitat and activities: With only one exception, all strains were isolated directly from soil or bat guano. The exception (UAMH 4190, KS2-1-2) was isolated from the liver and spleen of a mouse after injection with a soil suspension. R. flavissima does not appear to be pathogenic. Three strains (UAMH 4188, KS2-3-20-1; UAMH 4189, KS2-3-3B-1; UAMH 4141, KS2-3-15-1) represent cultures isolated from spleen and liver of mice injected intravenously with cultures obtained from soil, but no fungal elements could be found in these tissues.

Figs. 15-23. Renispora flavissima. (15,16 - UAMH 4140; 17 - UAMH 4188; 18,20,21 - UAMH 4184; 19 - UAMH 4191; 22,23 - UAMH 4185). Figs. 24-26. Ajellomyces capsulatus (UAMH 3536). Figs. 15-18,20. Spiny or tuberculate aleurioconidia borne on short or long lateral branches or directly on the sides of the hyphae, x600. Fig. 19. Aleurioconidia formed in short chains, x600. Fig. 21. Tuberculate aleurioconidia, x1680. Fig. 22. Aleurioconidia showing prominent finger-like tuberculations, x600. Fig. 23. Smooth-walled aleurioconidia, x600. Figs. 24-26. Aleurioconidia of Ajellomyces capsulatus. 24, x1680; 25-26, x600.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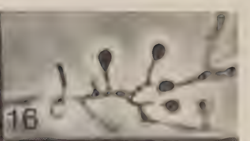
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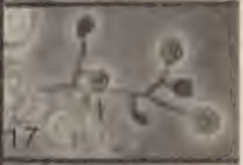
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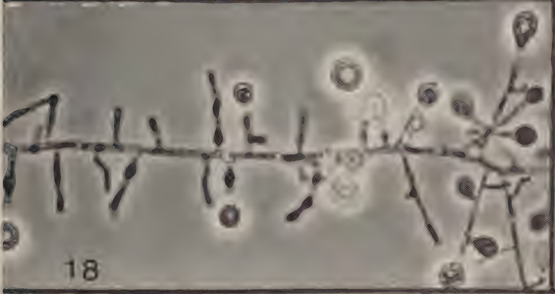
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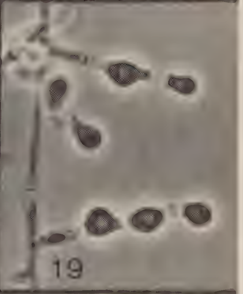
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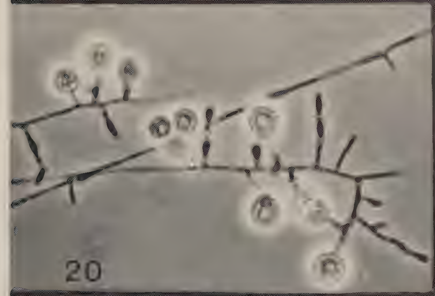
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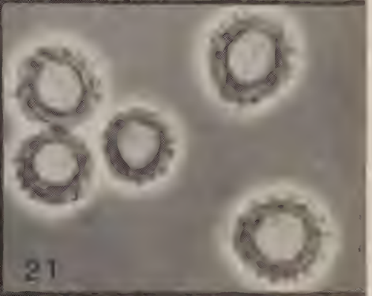
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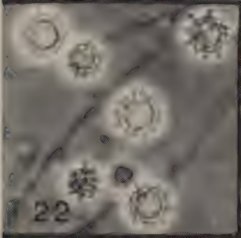
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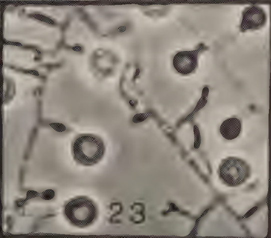
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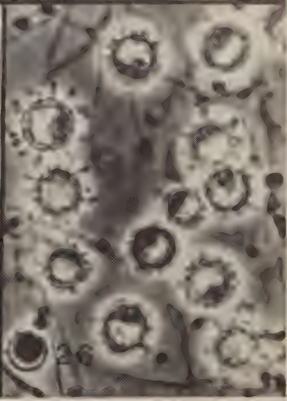
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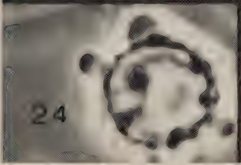
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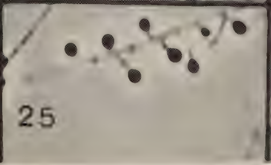
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Using the in vitro method for measuring keratinolytic activity (Sigler and Carmichael, 1976), the strains examined at UAMH were found to be moderately to markedly keratinolytic after 7-14 days. None digested cellophane.

Results of mating tests: Only 10 of 66 isolates were studied at UAMH. These were mated in all possible combinations using the procedures outlined previously (Sigler and Carmichael, 1976; p.353). All crosses were grown on oatmeal agar without cellophane at 25 C. Sterile hair was sprinkled over the surface of the medium, but it had no effect on the formation of gymnothecia.

After 5 weeks, gymnothecia became apparent under the stereoscopic microscope in plates inoculated with mixed conidial suspensions. Gymnothecia are tiny and not visible macroscopically. Most gymnothecia were mature by 6-7 weeks. Two strains (4188 and 4191) were incompatible with each other, but formed gymnothecia when mated with all other strains tested (4140, 4141, 4184, 4185, 4186, 4187, 4189, 4190). Therefore, 4188 and 4191 are designated as - mating types and the others as + mating types. Numerous gymnothecia (usually 50-150) were seen in most crosses. However even after 8 weeks, 4187 and 4190 produced <20 gymnothecia when crossed with either - mating type. Indeed, in the cross of 4190 x 4191, only two gymnothecia were found.

On plates inoculated by parallel inoculation of separate conidial suspensions, growth in the center of the plate was scant (Fig. 14) and compatibility between tester strains at first appeared poor. Gymnothecia developed slowly, only becoming apparent after eight to ten weeks and were fewer in number (usually <10-30) than those formed on plates inoculated with mixed suspensions. The results of crosses were similar except that 4187 and 4189 failed to cross with either - mating type. Also 4190 crossed with 4188 but not with 4191. The zone of scant growth in the center of the streaked plates suggests some inhibitory activity between tester strains.

Microscopic mounts prepared from the crosses of 4185 x 4188 and 4185 x 4191, revealed differences in the surface ornamentation of the aleurioconidia. In mounts from plates of mixed suspensions, aleurioconidia appeared regularly tuberculate. However, in mounts from streaked plates, the surface projections of many of the aleurioconidia were much broader and more variable giving the conidia a star-like appearance.

Notes on electron microscopy: A suspension of ascospores in distilled water was layered on to a 200-mesh, 3 mm copper grid coated on one side with Formvar (Ernest Fullam, N.Y.). The excessive curvature of the ascospore in Fig. 13 is probably the result of shrinkage of one face caused by a tear in the Formvar coating on the grid.

DISCUSSION

Although von Arx (1971, 1977) and Samson (1972) agree that genera of the Gymnoascaceae should be differentiated by the shape of the ascospores, the morphology of the ascomatal initials, and the structure of the asci, it is apparent to us after studying numerous Gymnoascaceae that the structure of the peridium must also be considered in delimitation of the genera. That is, if the gymnothecium is a net-like structure composed of differentiated, dematiaceous hyphae, this characteristic is an important generic feature. The nature of peridial appendages is useful in species delineation.

Renispora is distinct from all other genera of the Gymnoascaceae in having reniform or bacilliform pitted ascospores. In its gymnothecia, composed of poorly differentiated hyphae, it is similar to *Arachniotus* and *Narasimhella*. However *Renispora* regularly forms spherical, discrete gymnothecia, whereas the latter genera bear asci in confluent masses or naked clumps. Furthermore, both genera have oblate or lenticular ascospores which often have an equatorial rim or furrow, or even polar thickenings (von Arx, 1971). *Arachniotus* differs from *Renispora* in having spherical asci (von Arx, 1977) and *Narasimhella* is distinguished by its ring-like initials surrounding a central cell (von Arx, 1977). Finally, both genera are cellulolytic and neither has characteristic conidial states, although poorly differentiated arthroconidia may be present in a few species of *Arachniotus*.

Another genus lacking well-defined gymnothecia is *Petalosporus* Ghosh, Orr and Kuehn (1963). Although recently placed in synonymy with *Arachniotus* by von Arx (1977), *Petalosporus* differs from *Arachniotus* in having disarticulating thick-walled peridial hyphae and discoid, oblate ascospores. *Petalosporus* is better compared with *Shanorella* Benjamin (1956). The oblate ascospores of *Petalosporus* rule out the inclusion of *Renispora* in this genus.

Pseudogymnoascus is distinguished by its ellipsoid or fusiform, smooth ascospores and by its gymnothecium composed of a network of dematiaceous, thick-walled hyphae. The type species, *P. roseus*, has a *Geomyces* conidial state. However, the ascomatal initials and structure of asci appear similar to those of *Renispora*.

Ajellomyces differs from *Renispora* in having characteristic coiled appendages and globose ascospores (see Kwon-Chung, 1973). However, the *Chrysosporium* state of *R. flavissima* resembles the *Chrysosporium* state of *A. capsulatus*. The tuberculate aleurioconidia are similar in shape and size- 6-11(13)um in diameter for the *Chrysosporium* state of *R. flavissima* compared to 8-14um (Rippon, 1974) for the *C.* state of *A. capsulatus*. However, the tubercles of the B (brown) type conidia (Berliner, 1968) of the latter species are larger, finger-like projections (Figs. 24,26) often measuring 2-4um in length. These projections often show great variation in shape from narrow extensions to broader shapes with bud-like tips (Berliner, 1968; Garrison and Lane, 1973). In contrast, the aleurioconidia of the *C.* state of *R. flavissima* are more commonly spiny (Figs. 15-18) or coarsely tuberculate (Fig. 21) or even occasionally smooth-walled (Fig. 23). However, the aleurioconidia (Fig. 22) of one strain (UAMH 4185) formed prominent finger-like tubercles.

The *Chrysosporium* state of *R. flavissima* can be differentiated from the *C.* state of *A. capsulatus* by its distinctive yellow colonies. The colonies of *A. capsulatus* are white or buff-brown and usually downy. Furthermore *R. flavissima* neither produces microaleurioconidia as does *A. capsulatus* (Fig. 25) nor converts to a yeast phase when grown at 37 C.

The yellow color of the colonies and conidia of *R. flavissima* suggests the form-genus *Sepedonium*. Carmichael (1962) differentiated *Sepedonium* from *Chrysosporium* by its larger (usually 15-25um), golden-yellow aleurioconidia, by the accessory phialoconidial state present in most species and by sexual states in the Hypocreaceae rather than the Gymnoascaceae. Most *Sepedonium* species are mycoparasitic and digest cellulose, but not keratin.

In its tuberculate aleurioconidia, *R. flavissima* resembles some other species of *Chrysosporium*. The *Chrysosporium* state of *Corynascus sepedonium* (see Carmichael, 1962; von Arx, 1975) differs in bearing aleurioconidia on ampulliform swellings and in having orange-buff colonies. The *C.* state of *A. tuberculatum* (see Carmichael, 1962) is distinguished by its powdery, buff colonies and aleurioconidia which are pyriform or ovoid rather than globose or subglobose. The colonies of *Chrysosporium* state of *Arthroderma multifidum* (see Padhye and Carmichael, 1971) are yellowish to buff, often with a distinctive yellow surface growth. However, its roughened aleurioconidia are pyriform and larger (usually 6-12 x 9-20u) than those of *R. flavissima*.

Further investigations on the biological nature of this fungus will be reported by Gaur and Lichtwardt.

Cultures examined: UAMH 4140 (KS7-17-6), 4141 (KS2-3-15-1), 4184 (KS7-14-2), 4185 (KS7-13-5), 4186 (KS7-8-2), 4187 (KS7-16-4), 4188 (KS2-3-20-1), 4189 (KS2-3-3B-1), 4191 (KS7-15-7), all from soil in barn housing *Myotis velifer*, south-central Kansas, isolated by P.K. Gaur, 1976 and 1977. UAMH 4190 (KS2-1-2) isolated from liver and spleen of mouse after injection with soil suspension, by Gaur and Lichtwardt.

ACKNOWLEDGMENTS

We thank R. Sherburne and Dr. R.L.S. Whitehouse for preparing the electronmicrographs; Dr. L. Yung for doing the mating tests and Drs. S.J. Hughes and K.J. Kwon-Chung for reviewing the manuscript. We acknowledge financial support in part from Biomedical Sciences Support Grant RR07037 and University of Kansas General Research allocations 3210 and 3398 (to R.W.L.) and from the Natural Sciences and Engineering Research Council Canada (to J.W.C.).

REFERENCES

Arx, J.A. von. 1971. On Arachniotus and related genera of the Gymnoascaceae. Persoonia 6(3):371-380.
Arx, J.A. von. 1975. On Thielavia and some similar genera of Ascomycetes. CBS Studies in Mycology 8:20-21.
Arx, J.A. von. 1977. Notes on Gymnoascaceae. Persoonia 9(3):393-400.
Benjamin, R.K. 1956. A new genus of the Gymnoascaceae with a review of the other genera. El Aliso 3(3):301-328.
Berliner, M.D. 1968. Primary subcultures of Histoplasma capsulatum. I. Macro and micro-morphology of the mycelial phase. Sabouraudia 6(2):111-118.
Carmichael, J.W. 1962. Chrysosporium and some other aleuriosporic Hyphomycetes. Can. J. Bot. 40:1137-1173.
Garrison, R.G. and J.W. Lane. 1973. Scanning-beam electron microscopy of the conidia of the brown and albino filamentous varieties of Histoplasma capsulatum. Mycopath. et Mycol. appl. 49(2-3):185-191.
Ghosh, G.R., G.F. Orr and H.H. Kuehn. 1963. A new genus of the Gymnoascaceae with a rudimentary peridium. Mycopath. et Mycol. appl. 21(1):36-44.
Kwon-Chung, K.J. 1973. Studies on Emmonsiella capsulata. I. Heterothallism and development of the ascocarp. Mycologia 65(1):109-121.
McGinnis, M.R. and B. Katz. 1979. Ajellomyces and its synonym Emmonsiella. Mycotaxon 8(1):157-164.
Padhye, A.A. and J.W. Carmichael. 1971. The genus Arthroderma Berkeley. Can. J. Bot. 49(9):1525-1540.
Rippon, J.W. 1974. Medical Mycology. W.B. Saunders Co., Philadelphia.
Samson, R.A. 1972. Notes on Pseudogymnoascus, Gymnoascus and related genera. Acta Bot. Neerl. 21(5):517-527.
Sigler, L. and J.W. Carmichael. 1976. Taxonomy of Malbranchea and some other Hyphomycetes with arthroconidia. Mycotaxon 4(2):349-488.

MYCOTAXON

Vol. X, No. 1, pp. 142-154 October-December 1979

COMPARATIVE MORPHOLOGY AND TAXONOMIC DISPOSITION OF EBULBOSUS, QUADRIFIDUS, AND VARIEGATUS IN THE GENUS COPRINUS (AGARICALES)

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SUMMARY

The type collections of three C.H. Peck species from the *Picacei* group in *Coprinus* are critically compared. The results support the placement of *C. ebulbosus* and *C. quadrifidus* in synonymy under *C. variegatus*, a name given the taxon over twenty years earlier. Peck's conceptulization of his species is discussed and holotypic information from his unpublished notes is appended.

Over almost a quarter century period, Charles H. Peck described three taxa in *Coprinus* that would now be considered to be closely related members of the *Picacei* group. The three are large, often fugaciously annulate Coprini sometimes approaching in size *C. comatus* (Müll. ex Fr.) S.F.Gray, but usually more similar in stature to the robust *C. atramentarius* (Bull. ex Fr.) Fr. Other than their size, the dense, matted-fibrillose veil is the most distinctive macroscopic feature of the basidiocarps, particularly as it becomes torn and separated into conspicuous appressed-tomentose patches on the surface of the pileus. Peck and his associates found (as have subsequent researchers) that with few exceptions the fruiting period for *C. ebulbosus* (Pk.) Pk., *C. quadrifidus* Pk., and *C. variegatus* Pk. is spring and early summer rather than late fall as is most typical for *C. atramentarius* and *C. comatus*.

In Peck's descriptions, *C. ebulbosus*, *C. quadrifidus*, and *C. variegatus* were characterized on the basis of macroscopic features, the only comparable microscopic characteristic (spore size) being non-discriminating. Later mycologists have had difficulty in construing Peck's concepts of these taxa and confirming the presence of the three in their regional investigations of the North American flora. McIlvaine (1902), Hard (1908), and McDougall (1925) report (as variety or species) only *C. ebulbosus*. Bisby (1938), Christensen (1946), Smith (1958), and Groves (1962) mention only *C. quadrifidus*. Kauffman (1918) describes both *C. ebulbosus* and *C. quadrifidus*, as does Graham (1944). Graham, however, only includes *C. quadrifidus* in his key to his descriptions of Coprini. *Coprinus variegatus* evidently has not again been reported.

As an aid toward resolution of the confusion relative to the identity of these species, Peck's type collections have been examined and the results of the hyphal analyses critically evaluated. The recognized taxon is to be considered for North America as a whole after material has been received for study from a wide range of localities.

MATERIALS AND METHODS

For best revival, slide-mounts of herbarium material were hot-plate heated (without boiling) in a 2:1 chloral hydrate:water medium (CH). Spore measurements are given in face view followed by side view (profile). Abbreviations used in descriptions include $\bar{x}$ (mean or range of means), ± (more or less), L:W (ratio of spore length to face-view width), C (percent compression or ad-abaxial flattening of spores based on the percent difference between the mean widths in face and side views), w&c (wall and content), n.d. (not distinctive), and n.o.d. (not otherwise distinctive). When n.d., the wall is smooth, thin and colorless. Peck's descriptions give macroscopic and microscopic dimensions in inches (in.) and/or lines (one-twelfth inch). Bullerian terms for basidiocarp structure such as piloderma, pilocalyptra, cauloderma, and caulocalyptra have been considered elsewhere (Patrick & Barrows, 1979). Spacing cells, so characteristic of the *Coprinus* hymenium, have been called paraphyses, pseudoparaphyses, aborted basidia, basidioles, brachybasidioles, and brachycystidia by various authors. Terming them spacing cells is indicative of my complete agreement with Buller's (1909, p. 7) original assessment of their primary function in the hymenium. [The developing basidioles, of course, serve to support, and in a sense space, the random, enlarged basidia in aequihymeniiferous agarics. But in the inaequihymeniiferous genus *Coprinus*, the spacing cells are clearly not basidioles (i.e., not immature basidia).] The collections studied are from the New York Museum at Albany (NYS).

COMPARISON OF TYPES

For ease of comparison, the descriptions are interpolated in the same order as the names.

Coprinus ebulbosus[1]

  Coprinus quadrifidus

    Coprinus variegatus

Basidiocarps cespitose and sometimes in large tufts, base of cottonwood stumps or on decayed trunks or branches of trees in woods, June and July.

  Basidiocarps gregarious or cespitose, damp vegetable mold or much decayed wood under basswood trees, June.

    Basidiocarps densely cespitose, thin soil and decaying leaves covering rocks, with root-like threads at the base, June.

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[1] The macroscopic information includes data from the first full description of the taxon by Peck (1895) when he raised var. *ebulbosus* to species rank. It was based upon a conspecific, Elam Bartholomew collection from Rockport, Kansas.

Pileus thin, campanulate, 2-3 in. broad, variegated by the cuticle breaking into broad superficial persistent whitish scales, the surface beneath the cuticle somewhat striate, grayish brown, the margin at length revolute, lacerated.

Pileus thin, at first oval, then campanulate, finally ± expanded with the margin revolute, 2-3 in. broad, when young adorned with a superficial floccose-tomentose whitish or slightly yellowish veil which soon separates into evanescent flakes or scales and reveals the finely striate surface of the pileus, whitish becoming grayish or grayish brown with age, the margin often wavy or irregular.

Pileus fleshy, fragile, oblong-ovate, then campanulate, obtuse, 1-1.5 in. broad, hygrophanous, pale watery-brown when moist, whitish or cream color when dry, variegated by scales and patches of a superficial ochraceous tomentum (which peel off in flakes, revealing the smooth pileus beneath), the margin finely striate.

Lamellae narrow, thin, crowded, free, slate color becoming black, with spores 0.0003-0.0004 × 0.0002 inches.

Lamellae broad, thin, crowded, free, at first whitish, then dark purplish brown, finally black, with spores 0.0003-0.0004 × 0.00016-0.0002 inches.

Lamellae lanceolate, crowded, ascending, free, white, then rosy brown, finally black, with spores 0.00033 in. long.

Stipe equal (having no bulb), 3-6 in. long, 2-3 lines thick, hollow, white.

Stipe equal or slightly tapering upward, 3-4 in. long, 3-4 lines thick, hollow, floccose-squamulose, white, sometimes with a slight evanescent floccose ring near the base.

Stipe equal, brittle, 2-4 lines thick (plant 3-5 in. long), hollow, white, at first peronate-annulate, then floccose-pruinose, the slight abrupt annulus soon vanishes. Threads [rhizomorphs] white, branching.

Spores 7-9(9.5) × 4.5-5(5.2) × (4.2)4.5-5 µm (x̄ 8.1 × 4.8-4.9 × 4.8), L:W=1.53-1.83 (x̄ 1.67), in face view (fig. 1) naviculate-subelliptic, in profile inequilaterally subelliptic, ± terete (C=1-2%); germ pore exactly apical, 1.2 µm diam; wall smooth, rather thin, medium brown with reddish tinge (CH); content none apparent.

Spores 7-9(9.5) × 4.5-5.2(5.5) × 4.5-5(5.2) µm (x̄ 7.9-8.4 × 4.9-5.0 × 4.8-4.9), L:W=1.50-1.80 (x̄ 1.61-1.69), in face view (fig. 2) rather narrowly subfusoid to subelliptic, in profile inequilaterally narrow subelliptic to almost cylindric, ± terete (C=2-3%); germ pore exactly apical, 1.2 µm diam; wall smooth, relatively thin, medium brown to medium red-brown; content clear.

Spores (7)7.2-9(9.5) × 4.7-5.2 × 4.7-5.2 µm (x̄ 8.1-8.3 × 4.9-5.0 × 4.8-4.9), L:W=1.50-1.81 (x̄ 1.63-1.65), in face view (fig. 3) naviculate-subelliptic, in profile inequilaterally subelliptic, ± terete (C=1-2%); germ pore exactly apical, 1.2 µm diam; wall smooth, relatively thin, medium brown to medium reddish brown; content clear.

Basidia tetrasporous, dimorphic: utriform, ca. 27-30 × 7-7.5 µm, subpedicellate clavate, ca. 17-20 × 6.5-7.5 µm; w&c n.d.

Basidia tetrasporous, dimorphic: utriform (slightly strangulate above), ca. 24-29 × 7-7.5 µm, subpedicellate clavate, ca. 15-20 × 7-7.5 µm; w&c n.d.

Basidia tetrasporous, dimorphic: strangulate-utriform, ca. 23-30 × 7-7.5 µm, subpedicellate to pedicellate clavate, ca. 16-20 × 7-8 µm; w&c n.d.

Spacing Cells well differentiated in the hymenium, with 3-5 surrounding each basidium (x̄ 3.8), rounded subrectangular, 14-18 × 8-16 µm; w&c n.d.

Spacing Cells well differentiated, with 3-5 around each basidium (x̄ 4.2), rounded subrectangular, ca. 12-17 × 8-15 µm; w&c n.d.

Spacing Cells well differentiated, with 3-5 around each basidium (x̄ 4.1), rounded subrectangular, ca. 10-14 × 8-16 µm; w&c n.d.

Pleurocystidia abundant, very large, 98-206 × 22-35 µm, elongate obclavate with rounded apex; w&c n.d.

Pleurocystidia abundant but not reviving; w&c n.d.

Pleurocystidia present but not reviving; w&c n.d.

Cheilocystidia lost due to deliquescence of the margin.

Cheilocystidia not preserved.

Cheilocystidia not preserved.

Lamella Trama of interwoven, branching, narrow hyphae, 3-8 µm diam; w&c n.d.

Lamella Trama of branching, tightly interwoven, poorly reviving hyphae, ca. 4-8 µm diam; w&c n.d.

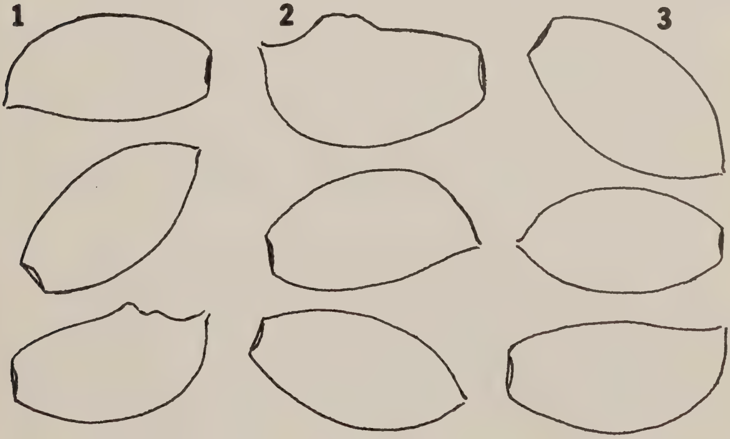
Lamella Trama of intricately and tightly interwoven, frequently branching hyphae, 3-7 µm diam; w&c n.d.

Pilocystidia absent.

Pilocystidia absent.

Pilocystidia absent.

Piloderma not distinctly differentiated from the trama.



Figs. 1-3. Type collection basidiospores (×3500). 1. *Coprinus ebulbosus*. 2. *Coprinus quadrifidus*. 3. *Coprinus variegatus*.

Piloderma not distinctly differentiated.

Piloderma not distinctly differentiated.

Pileus Trama of radially oriented, occasionally branching hyphae, yellowish in mass (CH); cells often huge and broadly elliptic to subfusoid, 4-38 µm diam (to 105 µm long); wall smooth, ± thin, nearly colorless; content n.d.

Pileus Trama of radial, occasionally branching hyphae, in mass light yellow; cells cylindric to often broadly elliptic, 5-39 µm diam, up to 100 µm (or more) long; w&c n.d.

Pileus Trama of poorly reviving, ± radial, occasionally branching hyphae, in mass golden ochraceous; cells cylindric, broadly elliptic, or even subvesiculose, 4-20 µm (or more) diam; w&c ± n.d.

Caulocystidia none found.

Caulocystidia none found.

Caulocystidia none found.

Cauloderma (upper stipe) a thin layer of interwoven, branching, ± non-diverticulate, narrow hyphae, 3-7 µm diam; wall smooth, thin, light yellow; content n.d.

Cauloderma (upper stipe) a thin, sporadically evident zone of intricately and tightly interwoven, branching, narrow hyphae, ca. 3-6 µm diam; w&c n.d.

Cauloderma (upper stipe) a poorly reviving, thin layer of intricately and tightly interwoven, branching hyphae; w&c n.d.

Stipe Trama of vertically parallel, hardly branching hyphae, 4-13 µm diam; w&c ± n.d.

Stipe Trama of parallel, infrequently branching filaments, 5-20 µm diam; w&c ± n.d.

Stipe Trama of parallel filaments, 3-16 µm diam; w&c ± n.d.

Veil Remnants on pileus (pilocalyptra) of much, rather tightly interwoven, branching hyphae, in mass medium ochraceous (CH); cells ± cylindric, 3-7(9) µm diam; wall smooth, ± thin, colorless to refractively ochraceous; content n.d. On lower stipe (caulocalyptra) of somewhat axially oriented, though interwoven, moderately branching, narrow hyphae, 2.5-6 μm diam; wall light yellow, n.o.d.

Veil Remnants. Pilocalyptra of quite interwoven, moderately branching hyphae; cells cylindric, 4-8(15) μm diam; wall smooth, often ornamented with highly refractive platelets of golden ochraceous material; content n.d. Caulocalyptra of much-interwoven, branching, narrow hyphae, 3-6 μm diam, in mass colorless to yellowish, n.o.d.

Veil Remnants. Pilocalyptra of subradial, very interwoven, moderately branching hyphae; cells cylindric, 3.5-6(8) μm diam; wall smooth to often ornamented with platelets of very refractive golden ochraceous material; content n.d. Caulocalyptra of intricately interwoven, moderately branching, narrow hyphae, 3-6 μm diam, in mass colorless to yellowish, n.o.d.

Clamp Connections abundant throughout the fruiting body.

Clamp Connections abundant throughout.

Clamp Connections abundant throughout.

Collections studied. USA: NEW YORK: ORLEANS CO.: C.E.Fairman s.n. (holotype of *C. ebulbosus*), Lyndonville, June [1890]. LIVINGSTON CO.: C.H.Peck s.n. (holotype of *C. quadrifidus*), Portage, June [1896]. ORANGE CO.: C.H.Peck s.n. (holotype of *C. variegatus*), slope of Crows' Nest near West Point, June [1871].

DISCUSSION

When proposing these three taxa in 1873, 1891, and 1897, respectively, it is evident from his observations and notes that Peck related them to species which are now placed in distinctly separate groups in today's infrageneric classification (Patrick, 1977). *Coprinus ebulbosus* was at first considered a variety of the European *C. picaceus* (Bull. ex Fr.) S.F.Gray, the type of *Coprinus* sect. *Picacei*. Four years hence, Peck described var. *ebulbosus* more fully and raised it to species level, having found it to differ consistently from

C. picaceus in its smaller stature, lack of a bulbous stipe base, and much smaller spores. Obvious additional differences were the American species' very cespitose habit ('about fifty grew in a solid clump, all united at the base') and association with decaying hardwood.

For *C. quadrifidus*, the above differences from *C. picaceus* would be equally applicable. Peck, however, didn't relate *C. quadrifidus* to *C. picaceus*, but rather referred it to "tribe *Tomentosi*", a group now considered for the most part consectional with the *Lanatuli* (Patrick, l.c.). The epithet, *quadrifidus*, is based on a non-specific feature of the type collection where Peck (1897) noted that, "When mature the pileus becomes perforated in the center and soon splits into three to five, commonly four, segments, the division extending a short distance down the stem, allowing the parts of the pileus to droop on the recurved upper parts of the stem." This condition, having to do with the thinness of the pileus trama, subumbilicate-perforating disc, and apically completely hollow stipe, is occasionally seen in other species of *Coprinus*.

As with his *C. quadrifidus*, Peck's *C. variegatus* has the same characteristics of *C. ebulbosus* that distinquish the latter from *C. picaceus*. However, Peck associated *C. variegatus* with a third sectional group in *Coprinus*. It was said to be "allied to *C. atramentarius*", type of the *Atramentarii*.

These relationships that Peck assumed for his species are of interest even though they were only rather tenuously based upon macroscopic aspects of the fruiting bodies. Such Gestaltal catagorization may explain sufficiently Peck's continued recognition of them over the years, whereas the data presented here from critical comparison of the types quite conclusively show *C. ebulbosus*, *C. quadrifidus*, and *C. variegatus* to be synonymous. Even macroscopically, the approximately one hundred year-old type collections appear similar, and the analysis of spore and hyphal structures reveals no significant differences. Peck's descriptions of the freshly collected basidiocarps also indicate equivalence, the color variation, as well as unquantified lamellar differences, being well within the range observed by the author in over twenty personal collections of the species. It's probable, with no keys or other means of comparison published, that Peck had distinct concepts of *C. ebulbosus*, *C. quadrifidus*, and the much antecedent *C. variegatus*, by having had associated their respective original collections with quite different taxa. Of course there is also the possibility that Peck simply no longer had *C. variegatus* in mind after such a long period (and his tremendous contribution of so many new North American taxa) prior to when the others were described. But with *C. ebulbosus* and *C. quadrifidus*, their close chronology (1891, 1895, 1897) is more suggestive of his having pegged them at first sight to the relatively distantly related *C. picaceus* and *C. tomentosus*[1], rather than having ever critically compared them themselves.

Alexander H. Smith (1948), in his study of many of Peck's types in *Coprinus*, emphasized the importance of first having extensive knowledge from nature of a group as prerequisite to an accurate interpretation of diagnostic characters in what are often old and poorly preserved specimens. Peck's type collections were not preserved well by means of rapid and careful drying and interpretation of the pilear tissues is not easy unless sections are revived adequately in a heated chloral hydrate solution. Smith's distinction between the taxa (in KOH) on the basis of the narrow vs. broad cuticular hyphae was not substantiated since the "cuticle" is actually velar in *C. variegatus* when of filamentous, narrow hyphae. And, the "vesiculose cells" appear representative of outer tramal tissue in the holotypes. This can be readily confirmed in fresh or correctly dried collections whether determined (auct.) as *C. ebulbosus*, *C. quadrifidus*, or *C. variegatus*.

In addition, the "ventral hump" found by Smith (l.c.) on some spores in type material of *C. ebulbosus* and *C. variegatus* appears not to be taxonomically significant. This evident artifact is due to a more or less longitudinal, erumpent fissure in the lower adaxial surface and has been seen in several Coprini (as well as in *Psathyrella*) where the spore wall is relatively thin overall. It was observed by me on some spores in the type of *C. quadrifidus* also. Such adaxial rupturing could as well be indicative of over-heating of the specimens when drying as of tardiness in drying them. Germination, of course, occurs through the apical pore.

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[1] Ex commentariis ineditis Peckii.

Original observations by Peck on changes in spore deposit color are noteworthy. When a severed pileus of *C. variegatus* is placed on a slip of white paper and covered, the spore print produced and when at first viewed is a deep brown color with only the slightest reddish tinge. Immediately afterward, however, the exposure to open air effects a rapid blackening of the deposit as it dries. "The spores are not clear black but rather brownish-black at first, becoming black on exposure to the air.[1]" This characteristic of *C. variegatus* isn't unique among Coprini, but is most noticeable in the thinner-walled, phaeosporous species.

CONCLUSIONS

Coprinus variegatus Pk., Bull. Buffalo Soc. Nat. Sci. 1:54. 1873.

=*Coprinus ebulbosus* (Pk.) Pk., Bull. Torrey Bot. Club 22:491. 1895.

≡*Coprinus picaceus* (Bull. ex Fr.) S.F.Gray var. *ebulbosus* Pk., Ann. Rep. New York St. Mus. 44: 20. 1891.

=*Coprinus quadrifidus* Pk., Ann. Rep. New York St. Mus. 50:106. 1897.

ACKNOWLEDGMENTS

Appreciation is expressed to Dr. John Haines for the loan of the type collections and notes on each. Thanks also to Dr. Samuel Mazzer and Dr. Alexander Smith whose comments on the manuscript were very helpful.

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[1] Ibid.

LITERATURE CITED

Bisby, G.R. 1938. The Fungi of Manitoba and Saskatchewan. National Res. Council, Ottawa. 189 p.

Buller, A.H.R. 1909. Researches on Fungi. Vol. I. Longmans, Green & Co., London. 287 p.

Christensen, C.M. 1946. Keys to the Common Fleshy Fungi. Burgess Co., Minneapolis. 45 p.

Graham, V.O. 1944. Mushrooms of the Great Lakes Region. Chicago Acad. Sci. No. 5. 390 p., 49 pl.

Groves, J.W. 1962. Edible and Poisonous Mushrooms of Canada. Res. Branch, Canada Agric., Ottawa. 298 p.

Hard, M.E. 1908. The Mushroom Edible and Otherwise. Mushroom Publ. Co., Columbus. 609 p.

Kauffman, C.H. 1918. The Agaricaceae of Michigan. Vol. I. Mich. Geol. & Biol. Survey 26-5, Lansing, 924 p.

McDougall, W.B. 1925. Mushrooms. Houghton Mifflin Co., Riverside Press, Cambridge. 151 p.

McIlvaine, C. 1902. One Thousand American Fungi. Rev. Ed. (Re-issued, 1973, Something Else Press, West Glover.) 729 p.

Patrick, W.W. 1977. Sectional Nomenclature in the Genus *Coprinus*. Mycotaxon 6:341-355.

____& C.Barrows. 1979. Western Fungi: A New Mexico *Psathyrella* in the *Cystidiosae* of Subgenus *Homophron* Mycotaxon 9(in press).

Peck, C.H. 1873a. V. Descriptions of New Species of Fungi. Bull. Buffalo Soc. Nat. Sci. 1:41-72.

____. 1873b. Report of the Botanist [for 1871]. Ann. Rep. New York St. Mus. 25:57-124.

____. 1891. Annual Report of the State Botanist [for 1890]. Ann. Rep. New York St. Mus. 44:1-75.

____. 1895. New Species of Fungi. Bull. Torrey Bot. Club 22:485-493.

____. 1897. Annual Report of the State Botanist [for 1896]. Ann. Rep. New York St. Mus. 50:75-159.

Smith, A.H. 1948. Studies in the Dark-Spored Agarics. Mycologia 40:669-707.

____. 1958. Mushroom Hunter's Field Guide. Univ. of Michigan Press, Ann Arbor. 197 p.

(Addendum)

Additional information on *Coprinus variegatus* is contained in Peck's unpublished notes (Notebook 4:21; NYS). Quoted below is the actual original, though unpublished, desription of the type collection and it was the basis of Peck's (1873a, 1873b) twice-published account.

"Pileus ovate-campanulate, obtuse, fleshy, thin, at first entirely covered with a floccose coating, soon breaking up into ochraceous scales and separating in large patches, leaving a smooth hygrophanous watery brown pileus which is finely striate on the margin and becomes a creamy-white by drying; lamellae lanceolate, crowded, free, ascending, white, then changing to a rosy brown, then blackish brown color; stem equal, fibrous-fleshy, brittle, hollow, white pruinose-flocculent (in the early stage covered by the veil, hence peronate-annulate by the expansion of the pileus), with white branching rootlets at the base; spores blackish-brown.

"About the roots of trees and on this black soil covering rocks in woods. Slope of Crows Nest, June. 3'-5' high, 1'-1.5', stem 3"-4".

"A large densely caespitose species of the size and height of *C. atramentarius*, but very distinct from that species by its floccose seceding veil."

MYCOTAXON

Vol. X, No. 1, pp. 155-174 October-December 1979

THE GENUS COPRINUS IN WESTERN NORTH AMERICA, PART III: SECTION ATRAMENTARII[I]

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SUMMARY

This third paper of a series on western North American species of Coprinus considers 4 species and 2 varieties comprising the western representatives of the section Atramentarii. Three new species, Coprinus striatus, C. pinguisporus, and C. depressiceps are described. One new variety, C. atramentarius var. crassivelatus is described. A key to the species and varieties found in western North America is provided.

INTRODUCTION

In this third paper on western North American Coprini, 4 species and 2 varieties are added to those previously reported (Van De Bogart, 1976, 1979). Three species and one variety are described as new.

The materials and methods, terminology and color terminology are as used in the first paper of this series (Van De Bogart, 1976).

[I] This paper is based in part on a thesis submitted to the Graduate School of the University of Washington in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

All collections examined are deposited in the Mycological Herbarium of the University of Washington (WTU). The collections used for preparing the camera lucida drawings and in obtaining the microscopical data are indicated by an asterisk (*) after the collection number.

Coprinus Pers. per S. F. Gray, Section Atramentarii Fr. Epicrisis, p. 243, 1838.

True pileal surface outside of the apical disk composed of radially oriented, slender, cylindrical hyphae, at least near the apex in young specimens with small, appressed and usually brown, red-brown or yellow-brown colored scales composed of fibrils. The hyphae in these fibrils are aligned in parallel bundles within each scale but are oriented more or less at random to the radially oriented hyphae of the epicutis. These scales and fibrils often become merged with the epicutis in age, giving the pileus a glabrous appearance macroscopically. Universal veil devoid of sphaerocysts, pileocystidia and caulocystidia absent. Many large and characteristic pleurocystidia present as mechanical braces that hold adjacent lamellae apart. No true annulus present, but there is an annular line or flange on the stipe composed of slender, anastomosed, interwoven, occasionally clamped, septate, hyaline to yellow hyphae, marking the early position of the pileal margin against the stipe. Filaments of the annular zone same as those forming the scales of the pileus and base of the stipe, and often containing similar amorphous contents in some of the cells. Colored appressed scales like those at the pileal apex often present on the stipe below the annular line or flange. Spores usually less than 12 μm long and occasionally distinctly ornamented. Species of medium to large size, growing near trees and on disturbed soils, never coprophilous

TYPE SPECIES: Coprinus atramentarius (Bull. per Fr.) Fr. Epicrisis, p. 243, 1838.

Observations: The universal veil of the species of section Atramentarii seems to be unique. It is composed of mostly very slender, thin walled hyphae that usually contain a yellow to yellow-brown amorphous substance. With age or exposure, the walls of most of these hyphae seem to lyse, leaving this amorphous content behind as the only visual evidence of the veil. Sometimes the individual strands seem to merge into broad filaments and patches which form the colored scales of the stipe and pileus. The microscopical features seem to be uniform for these species, and most of the major differences are the pileal shape and the presence or absence of an umbo.

KEY TO TAXA OF SECTION *ATRAMENTARII*

A. Pileus with prominent brownish striations, but no plicate striations .... 1. *Coprinus striatus*

A. Pileus with no prominent brownish striations, but sometimes with small plicate striations ... B

B. Spores broadly ovate-ellipsoidal to subglobose .... 2. *Coprinus pinguisporus*

B. Spores mostly ellipsoidal or narrowly ovate-ellipsoidal but never subglobose ... C

C. Spores broadest in lateral view (laterally compressed); apex of pileus depressed .... 3. *Coprinus depressiceps*

C. Spores round in cross-section or broadest in dorsal view (dorsoventrally compressed); apex of pileus plane or umbonate .... D

D. Apex of pileus rounded, flattened, or truncate but never umbonate, veil always rather scanty and never present as thick areolate patches .... 4. *Coprinus atramentarius* var. *atramentarius*

D. Apex of pileus either umbonate or the veil rather abundant and often forming areolate patches .... E

E. Apex of pileus umbonate, veil not abundant ..... 5. *Coprinus atramentarius* var. *acuminatus*

E. Apex of pileus not umbonate, veil thick, often forming areolate patches .... 6. *Coprinus atramentarius* var. *crassivelatus*

1. Coprinus striatus VAN DE BOGART sp. nov. (Fig.1)

Pileus primo ovatus dein conicus, postea campanulatus, postremo revolutus, semper ad apicem umbonatus, primo 2.0-2.8 cm longus, post expansionem 3.0-4.0 cm latus, cremeialutaceus, ex apice ad marginem striis prominentibus brunneis radiantibus, apex brunneus, color pilei immutatus praeter locos per autolysem denigratos; pagina pilei glabra, non vere plicato-striata. Velum universale haud manifestum. Caro tenuis, fere membranacea, ad apicem usque ad 2.0 mm crassa. Stipes cavus, basem versus angustatus, tum diametro maximo circa 1/3 longitudinis suis attingens, inde apicem versus satis angustatus, 8.0-10.0 cm longus, 2.4-5.5 mm crassus, albus praeter squamellas parvas brunneas in parte tertia baseos, opacus. Pagina stipitis laevis et glabra, etiam sericea supra basim leviter squamatam. Caro aliquantum fibrosa et usque ad 2.0 mm crassa. Lamellae angustae ellipsoideae, aliquot lamellulae adsunt, 1.0-2.6 cm longae, 0.8-1.0 cm latae, librae, primo confertae sic remanentes, per cystidia longa separatae quae inter paginas lamellarum contiguarum ponticulos facunt, primo pallidae dein pallide fuscae, postea satis atrobrunneae, autolysis completa.

Sporae ovatae, per transectionem rotundae, 6.5-8.8 x 4.4-5.0 μm, poro germininali apicali 1.8-2.1 μm lato, in cumulo atrobrunneiatrae, per microscopium brunneae, in 3% KOH mox pallidigriseae, guttulatae, rasilitunicatae. Basidia trimorphica, tetraspora; basidia breviter clavata 13.0-14.5 μm longa, 7.5 μm crassa, basidia longe clavata 16.2-20.0 μm longa, 8.8 μm crassa, basidia clavata longe pedicellata 22.5-28.8 μm longa, 6.2-8.8 μm crassa. Cheilocystidia ellipsoidea, 105.0-125.0 μm longa, 20.0-35.0 μm crassa, hyalina, rasilitunicata. Pleurocystidia anguste ellipsoidea, 105-144.5 μm longa, 19.0-36.5 μm crassa, hyalina, rasilitunicata, in lamella admodum contigua saepe per apicam inclusa. Pagina pilei e hyphis gracilibus cylindriceis radiantibus constans. Velum universale in pagina pilei et basi stipitis e fibrillis vel reliquiis fibrillarum constans. Elementa veli in pagina pilei pro parte maxima e contenta amorpha luteibrunnea cellularum tabidarum constantia, solum aliquot cellulae intactae remanentes. Cellulae veli stipitis nunc ad fragmenta amorpha luteibrunnea deminutae, nunc pro hyphis propriis videtur, quibus cylindricis, 1.2-2.5 μm diam, tenuitunicatis, et saepe contentis simillimis luteibrunneis quibus

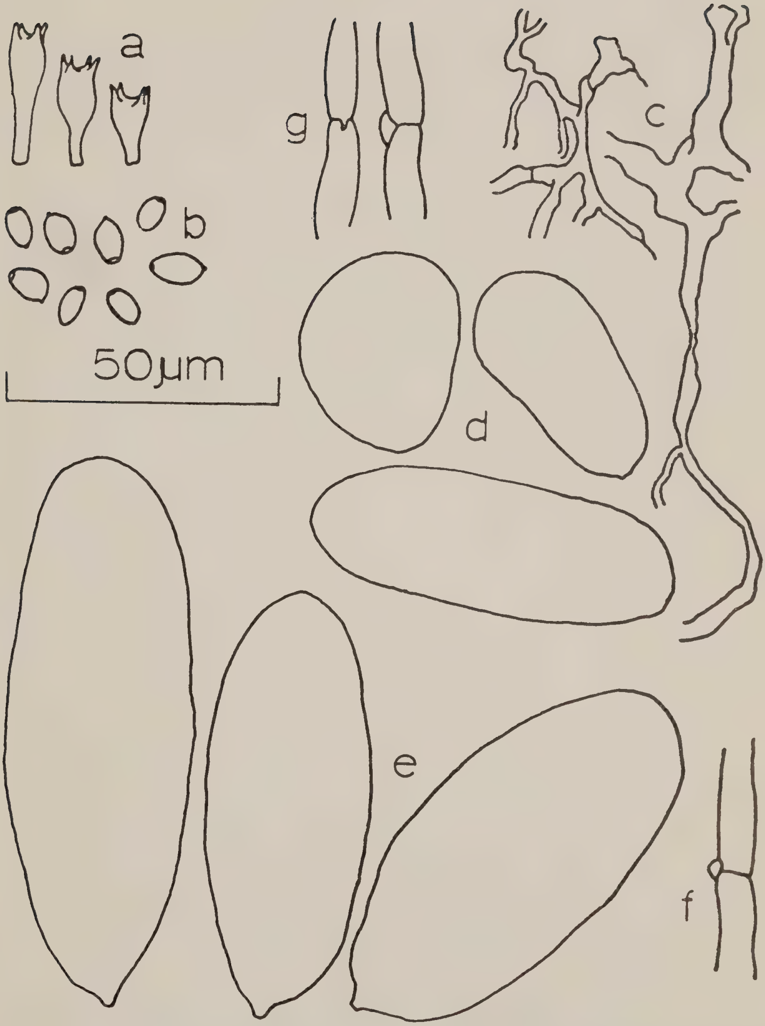

Fig. 1. Coprinus striatus FVDB 2168, a. basidia, b. spores, c. universal veil, d. cheilocystidia, e. pleurocystidia, f. stipe clamp connection, g. pileal trama clamp connections.

fragmentis amorphis sensim commiscunt.

Fibulae in stipite, pagina pilei, et in trama lamellarum adsunt.

Holotypus FVDB 2168, terrestris, solitarius vel in turmis parvis, in sylva Lee dicta in comitato Snohomish pagi Washingtonis 4 Novembris 1968 lectus, in herbario Universitatis Washingtonensis (WTU) conservatus.

PILEUS at first ovate, then conic, then campanulate, and finally revolute, always with an umbonate apex, prior to expansion 2.0-2.8 cm in length and after expansion 3.0-4.0 cm in breadth. Creamy pale tan with prominent, radially oriented brown striations from apex to margins, apex brown. Color remaining the same except where blackened by the products of autodigestion. No plicate striation develops. Surface glabrous to the unaided eye, no superficial evidence of a universal veil. Flesh thin, almost membranous, except at the apex where it is up to 2.0 mm thick.

STIPE hollow, narrow at base, then enlarging to a maximum diameter about one-third of the way up and then tapering to a fairly narrow apex 8.0-10.0 cm x 2.4-5.5 mm. White except for small brown scales on the lower one-third, opaque. Surface smooth and glabrous or even silky above the slightly scaly stipe base. Flesh somewhat fibrous and up to 2.0 mm thick.

LAMELLAE narrow ellipsoidal, some short lamellae present, 1.0-2.6 x 0.8-1.0 cm, free, crowded at first and remaining so, kept separate by long bridging pleurocystidia that prevent opposing lamellar faces from touching. Pale, then light brown and eventually deep brownish black. Autodigestion complete, the entire complement of lamellae as well as most of the pileal flesh being lysed.

ODOR AND TASTE not observed.

SPORES ovate, round in cross-section, 6.5-8.8 x 4.4-5.0 µm, apiculus of moderate size and visible, germ pore apical, 1.8-2.1 µm in diameter. Color en masse deep brownish black, microscopically medium brown in 3% KOH, guttulate, tending slowly to turn pale grey in 3% KOH after 10-12 minutes. Wall smooth.

BASIDIA trimorphic, short clavate and 13.0-14.5 x 7.5 µm, long clavate 16.2-20.0 x 8.8 µm, long pedicellate-clavate and 22.5-28.8 x 6.2-8.8 µm, all four-spored.

CYSTIDIA: Cheilocystidia ellipsoidal, 105.0-125.0 x 20.0-35.0 µm, hyaline, smooth. Pleurocystidia narrowly ellipsoidal, 105.0-144.5 x 19.0-36.5 µm, with a short pedicel, 2.0-3.0 µm long, hyaline, smooth. No other cystidia present.

PILEAL SURFACE of radially oriented slender cylindrical hyphae.

UNIVERSAL VEIL of fibrils or the remains of fibrils on pileal surface and stipe base, the veil elements on the pileal surface consisting almost entirely of the amorphous yellowish brown contents of broken-down cells, only a few intact cells remaining. Stipe veil elements sometimes reduced to patches of amorphous yellow-brown material and sometimes appearing as distinct slender cylindric hyphae 1.2-2.5 µm in diameter, thin walled and often with the same yellow-brown amorphous content, that often imperceptibly merge with the amorphous patches.

CLAMP CONNECTIONS present in stipe, on pileal surface, and in lamellar trama.

HABITAT terrestrial, on duff in coniferous woods, solitary or in small groups.

Observations: The pileal striations are very marked and are an easily recognizable feature of this species.

Material Examined. Washington: FVDB 147; HOLOTYPE, FVDB 2168*, 4 November, 1968.

2. Coprinus pinguisporus VAN DE BOGART sp. nov. (Fig. 2)

Pileus primo late conico-ovatus dein conico-expansus, demum per autolysem destructus, nunquam revolutus, primo 3.5-4.0 cm longus, post expansionem 3.0-4.0 cm latus ante diametro apicis stipitis per autolysem deminutus est, modice griseibrunneus, ad apicem brunneus demum in omni pileo sordide brunneus, haud plicato-striatus; pagina pilei ut videtur laevissima et

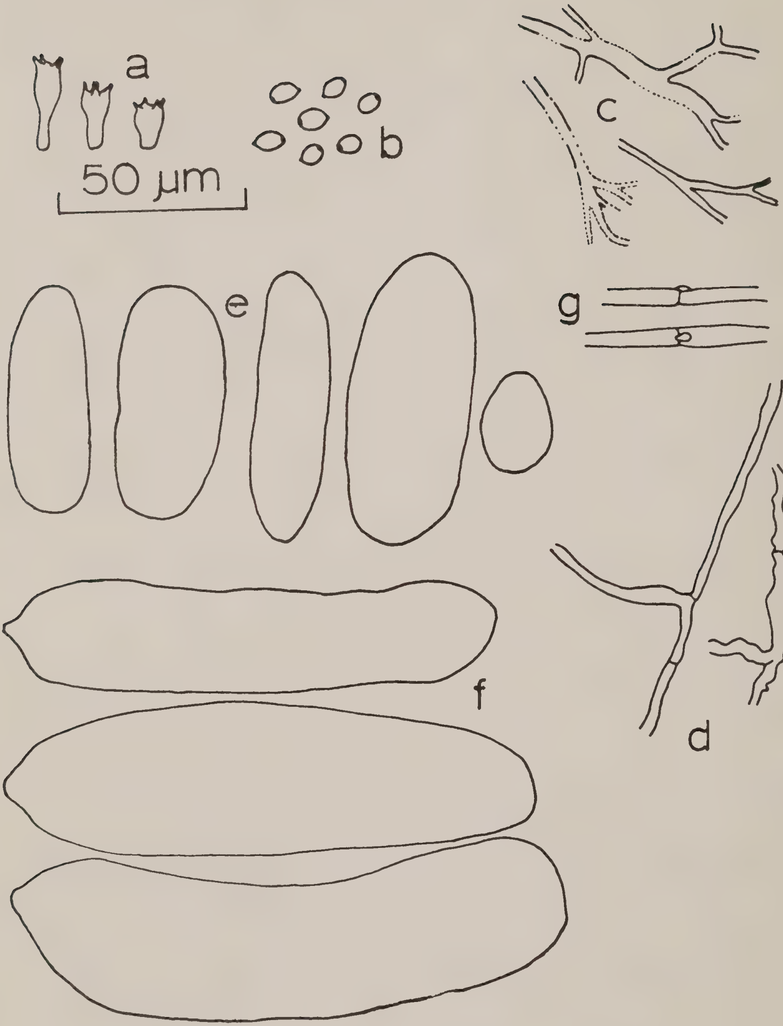

Fig. 2. Coprinus pinguisporus FVDB 17, a. basidia, b. spores, c. pileal universal veil, d. stipe universal veil, e. cheilocystidia, f. pleurocystidia, g. pileal trama clamp connections.

tantum squamas brunneas parvas adhaerentes et late dispersas praebens quas sericeas videntur. Caro ad marginem tenuis, apicem versus crassior usque ad 2.5 mm. Stipes cavus, gracilis sed diametro circa 1/3 longitudinis suis leviter amplificato, ad basim angustior et ad apicem etiam angustior, 7.0-11.0 cm longus, 4.0-8.0 mm crassus, albus, opacus; pagina pro parte maxima laevis praeter squamas paucas brunneas adpressas subter prominentia annuliformi in parte infera dilatata stipitis; pars superna stipitis laevis, subsericea. Prominentia annuliformis locus est, ubi margo pilei in paginam stipitis conjungitur. Caro fibrosa, 0.8-2.0 mm crassa. Lamellae anguste ellipsoideae, aliquot lamellulae adsunt sed haud manifestae, 2.0-3.8 cm longae, 0.7-1.0 cm crassae, liberae, ab initio confertissimae, ita usque ad autolysem remanentes, sordide albae dein pallidibrunneae et postremo atrobrunneae. Autolysis completa.

Sporae late ellipsoideae vel subglobosae, per transectionem rotundae, 5.6-8.4 x 4.2-5.0 µm, poro germinationis apicali 1.9-2.5 µm lato, tenuitunicatae, in cumulo atrobrunneae, per microscopium pallidibrunneae, contento guttulato. Basidia trimorphica, tetraspora; basidia breviter clavata 15.0-17.5 µm longa, 7.5-8.8 µm crassa, basidia longe clavata 20.0-22.5 µm longa, 7.5-8.8 µm crassa, basidia perlonge clavata 29.0-31.0 µm longa, 7.5-8.8 µm crassa. Cheilocystidia globosa 12.0-15.0 µm lata, cheilocystidia clavato-ellipsoidea 80.5-92.5 µm longa, 25.0-29.0 µm crassa, hyalina, tenuitunicata. Pleurocystidia ellipsoidea, 82.5-99.0 µm longa, 26.4-33.0 µm crassa, hyalina, tenuitunicata, pedicello brevi 1.0-3.0 µm longo, in lamella admodum contigua saepe per apicam inclusa. Pagina pilei ex hyphis cylindriceis radiantibus constans. Velum universale in pagina pilei e squamis parvis 1.0-2.0 mm longis, 0.5-1.0 mm crassis constans, quibus per microscopium hyphis gracilibus vel reliquiis hypharum constantur. Elementa veli in pagina pilei pro parte maxima e contentis amorphis luteibrunneis cellularum tabidarum constantia. Velum universale in basi stipitis et in zona annuliformi vel volviformi ex hyphis gracilis tenuitunicatis 1.0-3.0 µm diam, aliquantum anastomosantibus intertextissimis constans, hyphae veli stipitis saepe contentia pallidiluteibrunnea praebens.

Fibulae in pagina pilei, trama lamellarum, et in trama pilei adsunt. Sporocarpium odore et sapore nullo.

Holotypus FVDB 17, terrestris, cespitosus, in solo argillaceo ad basim alni, in sylva Castrae Sini Sulphuris dicta in comitato Snohomish pagi Washingtonis 16 Octobris 1965 lectus, in herbario Universitatis Washingtonis (WTU) conservatus.

PILEUS at first broadly conic-ovate, then spreading conic and eventually lysing, never revolute, prior to expansion 3.5-4.0 cm in length and after expansion 3.0-4.0 cm in breadth before being reduced to size of stipe apex by lysis. Medium grey-brown to brown at the apex and eventually becoming dark sordid brown over the entire pileus. No plicate striation, entire surface seeming very smooth and having only a few small brown, adherent, somewhat fibrillose-appearing scales that are widely scattered. Flesh thin at the margins and thicker towards the apex, up to 2.5 mm thick.

STIPE hollow, slender but slightly enlarged about one-third of the way up and narrower at the base and even narrower at the apex, 7.0-11.0 cm x 4.0-8.0 mm. White except for a few brownish adherent scales below a small ringlike flange on the enlarged portion of the lower stipe, opaque. Upper part of stipe smooth, somewhat silky. Ringlike flange present where immature cap margin rested on stipe surface. Flesh fibrous, 0.8-2.0 mm thick.

LAMELLAE narrowly ellipsoidal, some short lamellae present but not obvious, 2.0-3.8 x 0.7-1.0 cm, free, extremely crowded from the earliest stages and remaining so until lysis, sordid white, then pale brown and finally dark brown. Autodigestion consuming the entire pileus.

ODOR AND TASTE not observed.

SPORES broadly ovate-ellipsoidal to subglobose, round in cross-section, 5.6-8.4 x 4.2-5.0 μm, apiculus tiny and often not visible, germ pore apical, 1.9-2.5 μm in diameter. Color en masse dark brown, microscopically light brown in 3% KOH. Contents guttulate. Walls smooth.

BASIDIA trimorphic, short clavate and 15.0-17.5 x 7.5 8.8 μm, long clavate and 20.0-22.5 x 7.5-8.8 μm, very long clavate and 29.0-31.0 x 7.5-8.8 μm, all four-spored.

CYSTIDIA: Cheilocystidia globose, 12.0-15.0 µm in diameter or clavate-ellipsoidal, 80.5-92.5 x 25.0-29.0 µm, hyaline, smooth. Pleurocystidia ellipsoidal, 82.5-99.0 x 26.4-33.0 µm, hyaline, smooth, apices embedded in opposing lamella and bridging the interlamellar gap, with a short pedicel, 1.0-3.0 µm long. No other cystidia present.

PILEAL SURFACE of radially oriented cylindrical hyphae.

UNIVERSAL VEIL on pileus appearing as small scales 1.0-2.0 x 0.5-1.0 mm, microscopically made up of poorly defined remains of slender hyphae with amorphous yellow-brown contents left as a deposit when the cell walls of the hyphae lysed, the ringlike flange and small scales on the lower part of the stipe composed of thin walled, slender, somewhat anastomosed and very interwoven hyphae 1.0-3.0 µm in diameter that often have pale yellow-brown amorphous contents.

CLAMP CONNECTIONS present in lamellar trama, in pileal trama, and on pileal surface.

HABITAT sublignicolous, on clay soil at base of alder tree in campground, in large caespitose clumps.

Observations: This species is readily separable from others in the section by its very broad to subglobose spores.

Material Examined. Washington: HOLOTYPE, FVDB 17*, 16 October, 1965.

3. Coprinus depressiceps VAN DE BOGART sp. nov. (Fig. 3)

Pileus primo subglobosus dein globoso-conicus, ad apicem depressus, primo 2.5-3.5 cm longus, post expansionem 3.0-4.5 cm latus, postremo per autolysem destructus, griseibrunneus, ad apicem atrogriseibrunneus et sic remanens usque ad nigrescionem admodum ante autolysem; pagina pilei haud plicato-striata, pro parte maxima laevis et glabra, aliquot fibrillis parvis brunneis dispersis et adpressis. Caro ad marginem tenuis et apicem versus incrassata, usque ad 2.0 mm crassa.

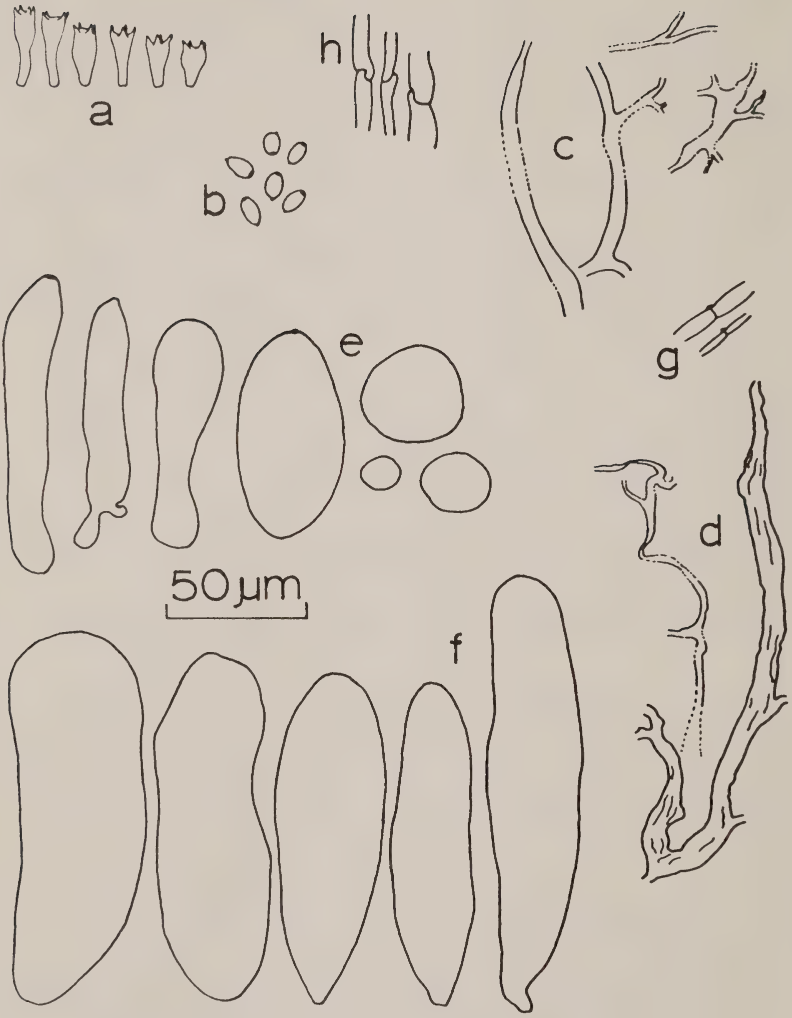

Fig. 3. Coprinus depressiceps FVDB 1745, a. basidia, b. spores, c. pileal universal veil, d. stipe universal veil, e. cheilocystidia, f. pleurocystidia, g. stipe clamp connections, h. pileal trama clamp connections.

Stipes cavus, longus et gracilis, in medio amplificatus, basim et apicem versus leviter contractus, basis in substrato peniter radicata, supra medium albus, infra medium laevis, sericeus, opacus vel notis coloratis exhibens. Zona parva annuliformi vel volviformi prope medium stipitis est locus ubi margo pilei immaturi in paginam stipitis conjungitur. Caro aliquantum crassa, fibrosa etsi friabilis, 1.0-3.0 mm crassa. Lamellae lanceolatae 1.0-3.3 cm longae, 0.8-1.1 cm crassae, ab initio confertissimae et sic remanens dum per autolysem destructae, sordide albae dein alutaceae, postea brunneipurpureae, postremo atrobrunneae; autolysis completa.

Sporae ellipsoideae, leviter complanatae, aspectu laterali latissimae, 7.5-9.0 x 4.5-5.4 µm, poro germinationis apicali 1.0-2.0 µm lato, in cumulo brunneiatrae, per microsporium fumosibrunneae, guttulatae, rasilitunicatae. Basidia trimorphica, tetraspora, basidia breviter clavata 13.5-17.5 µm longa, 8.0-8.5 µm crassa, basidia longe clavata 19.0-21.0 µm longa, 7.5-8.0 µm crassa, basidia longissima et clavata vel subululiformia 26.0-27.5 µm longa, 6.5-8.0 µm crassa. Cheilocystidia variabilissima, interdum globosa 14.0-36.0 µm lata, aliter ellipsoidea vel subcylindracea vel etiam subtibiiformia, 77.0-110.0 x 14.0-38.0 x 10.0-14.0 x 12.0-18.0 µm, hyalina, tenuitunicata, apicibus nunc obtusis nunc subcapitatis et aliquando irregulariter ramosis. Pleurocystidia ellipsoidea vel subcylindracea, 122.5-165.0 x 34.0-46.0 µm, longa, hyalina, tenuitunicata, interdum pedicello 2.0-8.0 µm. Pagina pilei ex hyphis cylindriceis radiatim dispositis. Velum universale ad basem stipitis et in pagina pilei ex frustillis squamiformibus quibus e multitudinibus coadunitis contentorum amorphorum luteibrunneorum hypharum gracilium cylindricarum facuntur; frustilla stipitis cum tomento laxo intexto hypharum gracilium tenuitunicatarum 1.0-2.5 µm diam commiscuntur; hyphae illae prominentiam annuliformem facunt. Hyphae tomenti illius contenta amorpha luteibrunnea aliquando habent.

Fibulae in trama lamellorum adsunt.

Holotypus FVDB 1745, terrestris vel sublignicola, in solo prope Salicem, solitarius vel in turmis parvis, in sylva Watermain dicta prope oppidum Redmond dictum, comitato King pagi Washingtonis 1 Novembris 1972 lectus, in herbario Universitatis Washingtonis (WTU) conservatus.

PILEUS at first subglobose then rounded conic, center of pileus depressed at apex. Prior to expansion 2.5-3.5 cm in length and after expansion 3.0-4.5 cm in breadth until reduced by autodigestion. Grey-brown to dark grey-brown at apex and remaining so until blackening just prior to autodigestion. No plicate striation. Surface mostly smooth, largely glabrous with only a few scattered small bits of brown fibrils appressed to it. Flesh thin at margin but thicker towards the apex, up to 2.0 mm thick.

STIPE hollow, long and slender, 8.0-10.0 cm x 4.0-9.0 mm, tapered slightly towards both base and apex from an enlarged portion in the middle. Base rooted deeply into the substratum. White above the enlarged portion and white with small brown appressed scales below the enlarged portion, opaque. Surface smooth or silky above and finely covered with small appressed scales or scale-like marks below. A small ringlike flange present on the swollen middle portion where the immature pileal margin was attached. Flesh somewhat thick, fibrous, although brittle, 1.0-3.0 mm thick.

LAMELLAE lanceolate, 1.0-3.3 x 0.8-1.1 cm, free, extremely crowded from the first and remaining so until destroyed by autodigestion, sordid white, then tan, then brownish purple, and finally deep blackish brown. Autodigestion destroying all of the lamellae and all of the pileal flesh except the apical disk.

SPORES ellipsoidal, slightly flattened, broadest in lateral view, 7.5-9.0 x 4.5-5.4 x 5.8-6.4 µm apiculus of moderate size, usually evident, germ pore apical, 1.0-2.0 µm in diameter. Color en masse dark brownish black, microscopically medium smoky brown. Contents guttulate. Wall smooth.

BASIDIA trimorphic, short clavate and 13.5-17.5 x 8.0-8.5 µm, long clavate and 19.0-21.0 x 7.5-8.0 µm, very long clavate to subululiform and 26.0-27.5 x 6.5-8.0 µm, all four-spored.

CYSTIDIA: Cheilocystidia very variable, some globose and 14.0-36.0 µm in diameter, others ellipsoidal to subcylindrical to subtibiiform, 77.0-110.0 x 14.0-38.0 x 10.0-14.0 x 12.0-18.0 µm, apices sometimes obtuse, sometimes subcapitate and occasionally irregularly branched, hyaline, smooth. Pleurocystidia ellipsoidal to subcylindrical, 122.5-165.0 x 34.0-46.0 µm sometimes with a pedicel 2.0-8.0 µm long, smooth, hyaline. No other cystidia present.

PILEAL SURFACE of radially oriented cylindrical hyphae.

UNIVERSAL VEIL of scalelike patches on stipe base and pileus composed of coalesced masses of the amorphous yellow-brown cellular contents of slender cylindric hyphae, those on the stipe merging imperceptibly with a loose, interwoven tomentum of slender, thin walled, cylindric hyphae 1.0-2.5 µm in diameter that makes up the ringlike flange. The slender hyphae of this tomentum also occasionally having the amorphous yellow-brown cell contents.

CLAMP CONNECTIONS present in the lamellar trama.

HABITAT terrestrial or sublignicolous, on soil around a willow tree in a mixed forest, solitary or in small clusters.

Observations: This species is recognizable by its depressed pileal apex and by the laterally flattened spores. It resembles C. soboliferus Fr., Epicrisis, p. 243, 1838, with its depressed disk.

Material Examined. Washington: HOLOTYPE, FVDB 1745*, 1 November, 1972.

4. Coprinus atramentarius (Bull. per Fr.) Fr. var. atramentarius (Fig. 4)

PILEUS shape variable at first, globose, subglobose, short-glandiform, ovate, subconic and then broadly rounded conic, and often finally revolute or laciniate. Prior to expansion 2.0-6.5 cm in length and after expansion 3.0-8.0 cm in breadth. Light greyish tan and medium brown at apex at first, becoming darker prior to blackening when it lyses. Small, poorly developed plicate striations present on some and not on others. Surface ranging from smooth and glabrous to the unaided eye to partially covered with small, brown, closely adherent scales.

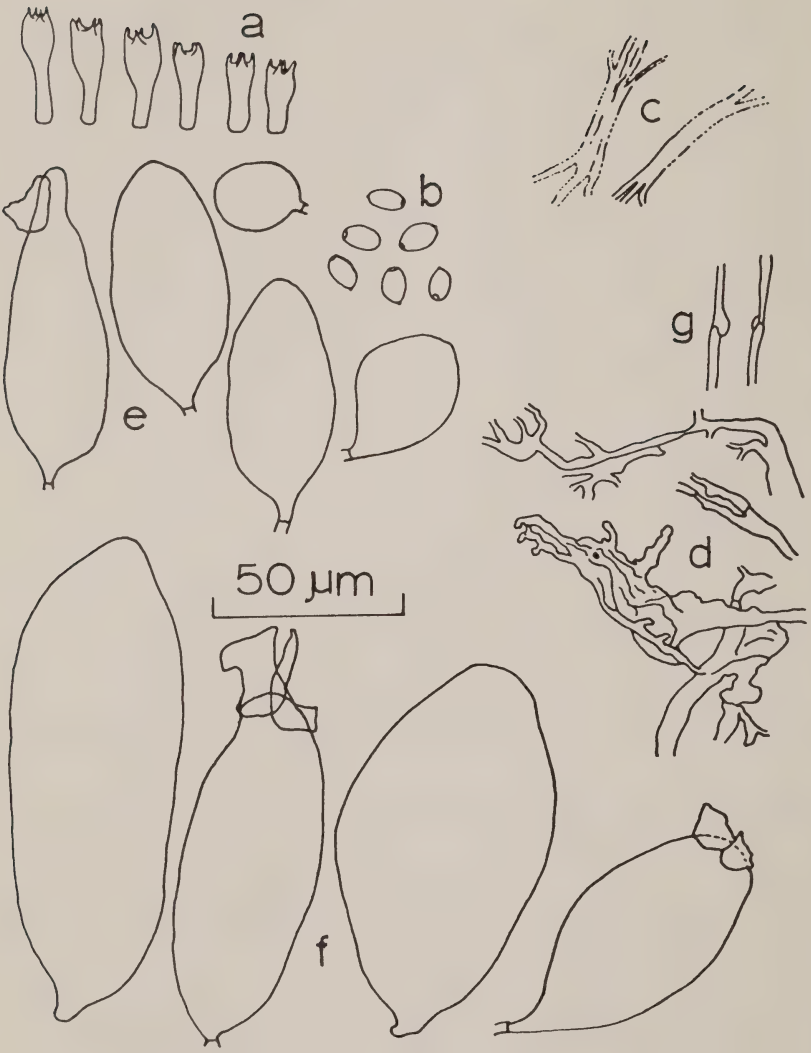

Fig. 4. Coprinus atramentarius var. atramentarius FVDB 1807, a. basidia, b. spores, c. pileal universal veil, d. stipe universal veil, e. cheilocystidia, f. pleurocystidia, g. stipe clamp connections.

Flesh ranging from thin and membranous at the margins to 3.0 mm thick at the apex in large specimens.

STIPE hollow, slender, tapering to both base and apex from a slightly enlarged area about one-third of the distance up from the base, 3.0-17.5 cm x 2.5-10.0 mm. White above the annular ring or flangelike zone, white with small appressed brown scales below this zone. Surface smooth and often silky in appearance above the annular zone and slightly roughened by the small appressed scales below it. Flesh thick and fibrous, sometimes brittle and sometimes rather tough, 1.0-3.5 mm thick.

LAMELLAE narrowly ellipsoidal, 4.5-6.2 x 1.4 cm, often shorter lamellae present, free and remote to broadly adnate, extremely crowded at first and remaining so until destroyed by autodigestion during spore liberation. Dingy white, then brown and finally deep brownish black.

ODOR AND TASTE; odor none, taste mild.

SPORES broadly ovate, narrowly ovate or ellipsoidal, round in cross-section or nearly so, (6.2-)8.1-10.0(-11.4) x (3.7-)4.4-6.5 µm, apiculus medium to small size, usually visible microscopically, germ pore apical 0.6-2.2 µm in diameter. Color en masse deep brownish black to almost black, microscopically light to medium brown or smoky brown, sometimes also with a purple tint in 3% KOH. Contents almost all guttulate. Wall smooth.

BASIDIA dimorphic, with only the first two basidial types present, or trimorphic, rarely tetramorphic, short clavate and 12.0-17.0 x 7.5 µm, long clavate and 17.5-22.5 x 7.5-8.8 µm, sphaeropedicellate to ululiform and 25.0-28.8 x 7.5-10.0 µm, very long ululiform and 35.6-37.4 x 8.8 µm all four-spored.

CYSTIDIA: Cheilocystidia globose, 13.8-50.0 µm in diameter or ovate to long ellipsoidal, 74.8-100.0 x 25.0-56.3 µm, smooth, hyaline. Pleurocystidia subcylindrical to ellipsoidal, 59.0-214.0 x 16.5-75.0 µm, smooth, hyaline, occasionally pedicellate, the pedicel 1.0-7.0 µm in length. No other cystidia present.

PILEAL SURFACE of radially oriented, slender, cylindrical hyphae, hyaline to pale yellow in 3% KOH.

UNIVERSAL VEIL of pileus mostly of agglutinated, slender, thin walled hyphae 1.0-5.0(-25.0) μm in diameter, often seeming to be devoid of any walls, with only a mass of amorphous yellow-brown cellular contents remaining, some of the individual hyphae with the same amorphous contents sometimes visible. These hyphae often oriented more or less parallel to each other but not necessarily parallel to the radially oriented surface hyphae, producing the small brown colored surface scales on both the pileus and stipe base, and also making up the annular ringlike zone on the enlarged area of the stipe. This zone is composed of a tomentum of slender, thin walled, branched and anastomosed cylindrical hyphae, some of which contain the amorphous yellow-brown cellular contents of the other universal veil cells. The tomentum merges gradually into the scales of the lower stipe.

CLAMP CONNECTIONS present on the stipe, usually on the pileal surface, occasionally in the lamellar trama.

HABITAT seemingly terrestrial or sublignicolous, or even lignicolous, usually on soil and frequently near rotting wood and especially partially buried rotting wood. Rarely found directly on rotting wood of Populus trichocarpa. Solitary or in loose groups of several to many or in dense caespitose clusters.

Observations: This species is very uniform in its pigmentation, its overall form, and its universal veil characteristics. There is, however, some variation in the number of basidial sizes and shapes, the spore size and shape, and the pileal shape in young expanding specimens. At the present time no correlations between the several variable features seem to be detectable, hence only two varietal names are given. However, future work may necessitate the use of other varietal names, or even the splitting of C. atramentarius into more than one species.

Material Examined. Washington: FVDB 9, 11, 12, 31, 35, 36, 79, 84, 190, 197, 235, 1739, 1742, 1752, 1755, 1918, 2146, 2148, 2198. Utah: 1807*. British Columbia, Canada: 2200.

5. Coprinus atramentarius var. acuminatus Romagn. Rev. de Myc., 16:127, 1951.

As described in variety atramentarius except that there is a prominent umbo present at the apex of the pileus.

Observations: Typical C. atramentarius in the Friesian sense has no umbo present according to Fries' description (Epicrisis, p. 243) and as shown in the illustrations cited by him. Romagnesi, in his description of var. acuminatus, states that the general stature of the sporocarp is smaller than in variety atramentarius yet the measurements given are essentially the same. The same is true of the sizes he reports for pileal scales and spores. The only real difference is the presence of the umbo. Romagnesi restricts the varietal name acuminatus to sporocarps with acutely conical-shaped pilei, while I include those with ovate and more or less globose pilei as well, all of which possess an umbo. Since the full range of slight variations in spores, basidia, and universal veil occurs in both var. acuminatus and in var. atramentarius, it would be preferable to include all variants of pileal shape that possess an umbo in var. acuminatus.

Material Examined. Washington: FVDB 1, 18, 24, 99, 168, 179, 192, 230, 231, 253, 255, 263, 1713, 1727, 1731, 1734, 1735, 1737, 1741, 1748, 1750, 1753, 2162, 2164, 2175, 2190. Arizona: 1813.

6. Coprinus atramentarius var. crassivelatus VAN DE BOGART var. nov. (Fig. 5)

A typo differt velo universali multo magis abundanti quam in typo, quo in fragmento areolato in pagina pilei fatiscitur.

Holotypus FVDB 2147 in solo, in turmis parvis, prope Christ Church in oppido Pateros dicto, comitato Okanogan pagi Washingtonis 12 Maius 1941 lectus, in herbario Universitatis Washingtonis (WTU) conservatus.

As described in var. atramentarius except that the universal veil is much more abundant and breaks up into areolate patches on the pileal surface.

Material Examined. Washington: FVDB 2147*.

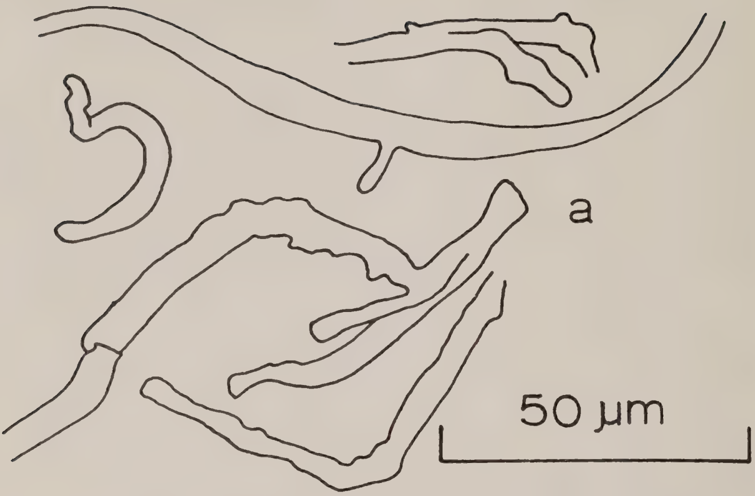

Fig. 5. Coprinus atramentarius var. crassivelatus FVDB 2147, a. universal veil.

ACKNOWLEDGMENTS

The author wishes to thank Dr. D. E. Stuntz for his comments and criticism while preparing the manuscript and especially for his assistance in the preparation of the Latin descriptions.

LITERATURE CITED

Fries, E. M. 1838. Epicrisis Systematis Mycologici, Typographica Academica, Uppsala. 610 p.

Romagnesi, H. 1951. Étude de quelques Coprins, Revue de Mycologie, 16:108-128.

Van De Bogart, F. 1976. The genus COPRINUS in Western North America, Part I: Section COPRINUS. MYCOTAXON 4(1):233-275.

Van De Bogart, F. 1979. The genus COPRINUS in Western North America, Part II: Section LANATULI. MYCOTAXON 8:243-291.

MYCOTAXON

Vol. X, No. 1, pp. 175-200 October-December 1979

A STUDY OF *AMANITA* TYPES III. TAXA DESCRIBED BY W. A. MURRILL

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"One of the most distinctive figures in North American mycology was W. A. Murrill. He worked furiously, loved his vocation, did not hesitate to deviate from the middle of the road taxonomy, and in the field had an extremely discriminating eye" (Hesler, 1975).

Although he was recognized as being "an unusually perceptive field man" (Weber, 1961), Murrill did receive considerable criticism concerning his taxonomic and nomenclatural individualism. He irritated certain mycologists with his many name changes. To the present, however, many of his taxonomic concepts have been upheld by the most scrutinous examination.

Concerning the use of generic names Murrill deviated from the general practice by publishing many new species as *Venenarius* and *Vaginata*. He would, however, frequently list nomenclatural synonyms at the end of the publication, "for those using Saccardo" (Murrill, 1912), in which he would include the appropriate *Venenarius* = *Amanita* and *Vaginata* = *Amanitopsis* comparisons. There is a question, however, as to whether this listing of comparisons constitutes valid publication of the new *Amanita* or *Amanitopsis* combinations.

In the International Code of Botanical Nomenclature (Lanjouw, 1966) Article 34.1 states that a name is not validly published when it is not accepted by the author in the original publication; and article 34.4 states that alternative names are not validly published when proposed on or after Jan. 1, 1953. The question to be considered is whether or not Murrill accepted the names *Amanita* and *Amanitopsis* as alternative names.

In the discussion following the description of a new species Murrill would frequently use *Amanita* or *Amanitopsis* interchangeably or in substitution for *Venenarius* and *Vaginata* (Murrill, 1941). Also, all but one of his new species published after 1949 appeared as *Amanita* or *Amanitopsis* (Murrill, 1949; 1951; 1953; 1955).

Since Murrill apparently felt quite at ease in using these generic names interchangeably I feel that these should be recognized as alternative names. Therefore, the *Amanita* and *Amanitopsis* combinations frequently included by Murrill in his publications should be considered as validly published.

In this paper 44 type specimens named by Murrill are described for taxa in the genus *Amanita*. All descriptions are from direct examination of the type specimens with the exception of color (*in italics*), taken from the original description.

TYPES STUDIED

1. *Venenarius abruptiformis* Murrill. 1938. Mycologia 30(4): 360.
   ≡ *Amanita abruptiformis* (Murr.) Murrill. 1938. Mycologia 30(4): 371.

Holotype: Gainesville, Florida, 9-23. viii. 1937, W. A. Murrill 16048 (FLAS).

PILEUS: approximately 60 mm broad, convex to plano-convex, margin non-striate, *white, avellaneous-isabelline on disk*; volval remnants as thick patches on disc. LAMELLAE: free, crowded, *white, changing to dark-isabelline on drying*. STIPE: up to 65 x 7-9 mm, tapering slightly upward, apex slightly expanded, solid, slightly fibrillose, *white*, basal bulb abruptly marginate with rim about 3 mm high, ovoid, up to 35 x 30 mm; annulus superior, membranous, persistent, very thick and sturdy, *white*; volval remnants as a few patches in groove at bulb apex, *white, rarely purplish below*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-7 µm diam, only slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, no clamps. BASIDIA: up to 46 x 4.7-12.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus very conspicuous, moderately branched, up to 9 µm diam; inflated cells mostly terminal or short, terminal chains, broadly elliptic, up to 72 x 57 µm, and small clavate, up to 94 x 15 µm; volval material at base of stipe very similar to that above, but with more hyphae and cells more elongate. STIPE TRAMA: filamentous hyphae sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 281 x 31 µm. PARTIAL VEIL: almost completely filamentous hyphae, up to 7 µm diam, moderately branched, no clamps; inflated cells clavate, terminal, up to 60 x 10 µm.

SPORES: 7.0-7.8 x 11.7-14.1 µm ($\underline{E}$ = 1.67-1.81; $\underline{E}^m$ = 1.77), elongate, often adaxially flattened, hyaline, yellowish brown to weakly amyloid, thin walled; contents guttulate, apiculus sublateral, cylindric.

Bas (1969) has placed this taxon in synonymy with *Amanita mutabilis* Beardslee.

2. *Venenarius alliaceus* Murrill. 1941. Mycologia 33(4): 434.
   ≡ *Amanita alliacea* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Tung-oil Mill, west of Gainesville, Florida, 18. vi. 1938, 16418(FLAS).

PILEUS: approximately 52 mm broad, plano-convex, margin non-striate, *white*; volval remnants as thin, floccose patches covering pileus. LAMELLAE: free, crowded, *white*. STIPE: up to 55 x 7-10 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb fusiform, rooting; annulus delicate, adhering to gills, *white*; only a few floccose pieces of volva remaining at bulb apex.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-6 µm diam, strongly gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, no clamps. BASIDIA:

up to 54.5 x 4-11.7 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus very conspicuous, moderately branched, up to 8 µm diam; inflated cells few, terminal, mostly elliptical, up to 75 x 32 µm, but with a few, smaller, ovoid, cells: volval material at base of stipe similar to that on pileus, but more densely compact, cells more abundant but smaller. STIPE TRAMA: filamentous hyphae sparsely branched, up to 9 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 312 x 34 µm. PARTIAL VEIL: mostly filamentous hyphae, moderately branched, up to 6 µm diam, no clamps; inflated cells ovoid to elliptic, terminal, up to 30 x 10 µm.

SPORES: (3.1)3.9-4.7 x 10.2-13.3 µm ($\underline{E}$ = 2.62-3.41; $\underline{E}^m$ = 2.97), cylindrical, often adaxially flattened, hyaline, amyloid, thin walled: contents guttulate, apiculus sublateral, cylindrical.

3. *Venenarius anisatus* Murrill. 1944. Lloydia 7(4): 314.
≡ *Amanita anisata* (Murr.) Murrill. 1944. Lloydia 7(4): 327.

Holotype: Gainesville, Florida, 25. vi. 1938, W. A. Murrill 16364 (FLAS).

PILEUS: 50 mm broad, plano-convex, margin non-striate, slightly incurved, *white*; volval remnants as slight pulverulence on pileus margin. LAMELLAE: widely free, very crowded, *white*. STIPE: 40 x 7 mm, subcylindric, solid, *white*, basal bulb ovoid, submarginate, 28 x 22 mm; annulus superior, fragments adhering to stipe, *white*; volval remnants as a few pieces of a shallow rim on bulb margin.

PILEIPELLIS: filamentous hyphae interwoven, densely packed, 3-8 µm diam, only slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 70 x 4-12 µm, 4-sterigmate, no clamps. VOLVA: on pileus almost completely filamentous hyphae, moderately branched, up to 9 µm diam, no clamps; inflated cells very rare, then being elongate, small: volval material at base of stipe with filamentous hyphae dominant, similar to that on pileus; inflated cells more conspicuous, broadly elliptic to short clavate, terminal or short, terminal chains, up to 62.6 x 46 µm. STIPE TRAMA: filamentous hyphae sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 290 x 31 µm. PARTIAL VEIL: almost completely filamentous hyphae, up to 6 µm diam, moderately branched, no clamps; inflated cells rare, short clavate.

SPORES: 6.2-7.0(7.8) x 10.9-11.7(12.1) µm ($\underline{E}$ = 1.50-1.84; $\underline{E}^m$ = 1.74), elliptic to elongate, often adaxially flattened, hyaline, yellowish to weakly amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

Bas (1969) has placed this taxon in synonymy with *Amanita mutabilis* Beardslee.

4. *Venenarius cylindrisporiformis* Murrill. 1944. Proc. Fla. Acad. Sci. vii: 114.
≡ *Amanita cylindrisporiformis* (Murr.) Murrill. 1944. Proc. Fla. Acad. Sci. vii: 127.

Holotype: Green Cove Springs, Clay Co., Florida, 27. vii. 1939, W. A. Murrill 16301(FLAS).

PILEUS: 35 mm broad, plano-convex, margin non-striate, *white*; no volval remnants remaining. LAMELLAE: free, moderately close, *white, brownish after drying*. STIPE: 35 x 2-4 mm, tapering slightly upward, solid, *white*, basal bulb elliptic; annulus superior, delicate, membranous, pendant, *white*; volva membranous, saccate, thick, approximately 10 mm deep, *white*.

PILEIPELLIS: filamentous hyphae radial to interwoven, 2-8 μm diam, thin layer of gelatinized hyphae at surface. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 47 x 3.5-11.8 μm, 4-sterigmate, no clamps. VOLVA: no remnants on pileus: volval material at base of stipe with two layers; outer layer almost completely filamentous hyphae, moderately branched, up to 8 μm diam, no clamps, with only occasional inflated cells, broadly elliptic, up to 93.9 x 62.6 μm, and elongate, up to 94 x 25 μm; inner layer quite similar, but with many more smaller, inflated cells. STIPE TRAMA: filamentous sparsely branched, moderately conspicuous, up to 7 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 250 x 22 μm. PARTIAL VEIL: almost completely filamentous hyphae, interwoven, moderately branched, up to 7 μm diam, no clamps; inflated cells only occasional, clavate, terminal, up to 40 x 8 μm.

SPORES: 3.9-4.7 x 10.9-13.3 μm ($\underline{E}$ = 2.49-3.21; $\underline{E}^m$ = 2.87), cylindrical to bacilliform, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, truncate-conic.

5. *Venenarius flavescens* Murrill. 1951. Bull. Flor. Agric. Exp. Stn. 478: 24.
≡ *Amanita rhoadsii* var. *flavotingens* Bas. Persoonia 5(4): 285-579.

Holotype: Gainesville, Florida, 10. vi. 1950, W. A. Murrill 21676 (FLAS).

PILEUS: 50 mm broad, plano-convex, margin slightly striate, inrolled, *white, turning yellow when bruised*; volval remnants as pulverulent material covering entire pileus, denser on disc. LAMELLAE: free, moderately crowded, *white, yellow where bruised*. STIPE: 35 x 4-6 mm, slightly expanded at apex, solid, bulb subradicate, marginate, 32 x 17 mm, *white, yellow where bruised*; exannulate; volva as slight pulverulence at apex of basal bulb.

PILEIPELLIS: filamentous hyphae interwoven, 3-6 μm diam, strongly gelatinized. PILEUS TRAMA; elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae inflated ramose, no clamps. BASIDIA: up to 51 x 4-11 μm, 4-sterigmate, clamps rare. VOLVA: filamentous hyphae on pileus relatively sparse, up to 8 μm diam, moderately branched; inflated cells variform, predominantly clavate to elliptic, with few globose to subglobose, up to 70 x 65 μm: volval material at base of stipe similar, cells slightly larger and less abundant. STIPE TRAMA: filamentous hyphae sparsely branched, relatively inconspicuous, up to 6 μm diam, no clamps; inflated cells terminal, clavate to fusiform, longitudinally oriented, up to 60 x 8 μm.

SPORES: 3.9 x 10.2-11.7 μm ($\underline{E}$ = 2.62-3.00; $\underline{E}^m$ = 2.92), cylindrical, often adaxially flattened, hyaline, amyloid, thin walled;

contents guttulate, apiculus sublateral, cylindric.

6. *Amanita flavivolva* Murrill. 1953. Mycologia 45(5): 794.

Holotype: Gainesville, Florida, 16. vii. 1950, W. A. Murrill 19598 (FLAS).

PILEUS: approximately 50 mm broad, plano-convex, margin non-striate, *pale yellow with graying disc, whitish on margin*; no volval remnants remaining. LAMELLAE: narrowly adnexed to just free, crowded, *white*. STIPE: up to 66 x 4-7 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb ovoid, up to 18 x 14 mm; annulus superior, membranous, pendant, *white with flavous edge*; volva as very slight pulverulence at apex of bulb, *flavous*.

PILEIPELLIS: filamentous hyphae interwoven, 3-8 μm diam, only slightly gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, no clamps. BASIDIA: up to 40 x 3-9.5 μm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae moderately branched, conspicuous, up to 8 μm diam, no clamps; inflated cells terminal or short, terminal chains, subglobose to broadly elliptic, very few oblong elliptic, up to 63 x 47 μm: volval material at base of stipe similar, very sparse. STIPE TRAMA: filamentous hyphae abundant, sparsely branched, up to 7 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 300 x 16 μm. PARTIAL VEIL: mostly filamentous hyphae, moderately branched, up to 8 μm diam, no clamps; inflated cells broadly elliptic to oblong elliptic, terminal, up to 46 x 15 μm.

SPORES: 5.1-5.9 x 7.8-8.6 μm ($\underline{E}$ = 1.40-1.69; $\underline{E}^m$ = 1.49), elliptic to elongate, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short, cylindric.

7. *Amanitopsis floridana* Murrill. 1949. Mycologia 41(4): 490.

Holotype: Gainesville, Florida, 5. viii. 1948, W. A. Murrill 21484 (FLAS).

PILEUS: 32 mm broad, plane, margin distinctly striate, *avellaneous with blackish disc*; no volval remnants remaining. LAMELLAE: free, crowded, *milk-white*. STIPE: 31 x 2-6 mm, tapering upward, apex slightly expanded, hollow, *white*, no basal bulb; exannulate; volva membranous, saccate, lobed, very sturdy, *dirty-white*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 2-8 μm diam, many hyphae gelatinized. PILEUS TRAMA: elongate, inflated cells, and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, clamped. BASIDIA: up to 54.5 x 4-20 μm, 4-sterigmate, clamped. VOLVA: no remnants remaining on pileus: volval material at base of stipe layered; outer layer exclusively filamentous hyphae, moderately branched, up to 9.5 μm diam, no clamps; inner layer also filamentous hyphae with considerable gelatinized hyphae. STIPE TRAMA: filamentous hyphae sparsely branched, conspicuous, up to 7 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 170 x 22 μm.

SPORES: 7.0-7.8(8.2) x (12.5)13.3-13.7(14.1) μm ($\underline{E}$ = 1.67-2.00; $\underline{E}^m$ = 1.76), elongate, often adaxially flattened, hyaline, non-amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

8. *Venenarius fraternus* Murrill. 1941. Mycologia 33(4): 436-437.
≡ *Amanita fraterna* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Gainesville, Florida, 7. vi. 1938, W. A. Murrill 16376(FLAS).

PILEUS: up to 30 mm broad, plano-convex, margin non-striate, *dull melleous with subfuliginous disc*; volval remnants as a few, randomly distributed, floccose patches. LAMELLAE: narrowly adnexed to just free, crowded, *white*. STIPE: up to 55 x 2-3 mm, tapering upward, apex slightly expanded, *rosy-isabelline*; annulus superior, membranous, delicate, missing in some specimens, *white*; volval remnants as floccose patches on apex of bulb and lower stipe.

PILEIPELLIS: filamentous hyphae interwoven to subradial, slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: unable to reinflate tissues. BASIDIA: up to 47 x 4-11 μm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae inconspicuous, moderately branched, up to 7 μm diam; inflated cells dominant, terminal and short, terminal chains, globose, subglobose, broadly elliptic, ovoid, up to 63 x 53 μm, with some oblong elliptic to clavate, up to 65 x 18 μm: volval material at base of stipe similar to that on pileus but with more filamentous hyphae. STIPE TRAMA: filamentous hyphae inconspicuous, sparsely branched, up to 8 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 310 x 31 μm. PARTIAL VEIL: almost exclusively filamentous hyphae, moderately branched, up to 7 μm diam, no clamps; inflated cells few, small, clavate,

SPORES: 5.5-5.9 x 7.8-8.6 μm ($\underline{E}$ = 1.32-1.56; $\underline{E^m}$ = 1.46), elliptic, often adaxially flattened, hyaline, weakly amyloid, thin walled; contents guttulate, apiculus sublateral, short, truncate-conic.

9. *Venenarius gemmatus* var. *volvatus* Murrill. 1941. Mycologia 33(4): 437.
≡ *Amanita murrilliana* Singer. 1949. Lilloa 22: 385.

Holotype: Gainesville, Florida, 28. v. 1938, W. A. Murrill 16224 (FLAS).

PILEUS: 50 mm broad, plano-convex, margin distinctly striate, *cremeous, dark isabelline on the disc, margin almost white*; no volval remnants remaining. LAMELLAE: free, but connected to stipe by line, crowded, *white*. STIPE: 130 x 4-7 mm, tapering upward, stuffed to hollow, *white*, no basal bulb; only slight annular remains approximately 35 mm from apex of stipe, *white*; volva membranous, saccate, lobed, 30 mm high.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-7 μm diam, gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: unable to reinflate. BASIDIA: up to 54 x 6.5-15.5 μm, 4-sterigmate, no clamps. VOLVA: no volval remnants on pileus: volval material on base of stipe layered; outer layer completely filamentous hyphae, interwoven, moderately branched, no clamps, up to 9 μm diam; inner layer mostly filamentous hyphae as in outer layer, but with few, terminal, inflated cells. STIPE TRAMA: filamentous hyphae sparsely branched, very inconspicuous, up to 7 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 130 x 31 μm. PARTIAL VEIL: almost completely filamentous hyphae, moderately branched, up to 7 μm diam, no clamps; inflated cells few, elongate, terminal, up to 60 x 15 μm.

SPORES: (7.0)7.8-8.6(9.4) x (10.9)11.7-13.3(14.1) μm ($\underline{E}$ = 1.33-1.67; $\underline{E}^{m}$ = 1.52), elliptic to elongate, often adaxially flattened, hyaline, non-amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

10. *Venenarius maculans* Murrill. 1944. Lloydia 7(4): 314-315.
≡ *Amanita maculans* (Murr.) Murrill. 1944. Lloydia 7(4): 327.

Holotype: northwest of High Springs, Columbia Co., Florida, 14. xii. 1941, W. A. Murrill 20157(FLAS).

PILEUS: up to 33 mm broad, convex to plano-convex to plane, margin slightly incurved, non-striate, *white or lemon-tinted, sometimes isabelline on the disk or in spots*; volva sparse as thin, floccose-membranous crust. LAMELLAE: free, crowded, *white*. STIPE: up to 70 x 4-7 mm, tapering upward, apex slightly expanded, solid, *white, becoming reddish where bruised*, basal bulb globose to subglobose; annulus evanescent, superior, submembranous, *white*; volval remnants floccose-membranous, occasional lobe at apex of bulb.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-7 μm diam, slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, no clamps. BASIDIA: up to 43 x 4-11.5 μm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus moderately inconspicuous, sparsely branched, up to 7 μm diam, no clamps; inflated cells dominant, subglobose to broadly elliptic, up to 66 x 62.6 μm and rarely elliptic, up to 93 x 31 μm, terminal chains: volval material at base of stipe with more filamentous hyphae, similar to that on pileus, and with more elongate, inflated cells. STIPE TRAMA: filamentous hyphae sparsely branched, up to 7 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 188 x 31.3 μm. PARTIAL VEIL: filamentous hyphae inconspicuous, sparsely branched, up to 7 μm diam, no clamps; inflated cells dominant, subglobose to broadly elliptic, up to 35 x 30 μm.

SPORES: 7.8-8.6 x (7.8)8.6 μm ($\underline{E}$ = 1.0-1.1; $\underline{E}^{m}$ = 1.04), globose to subglobose, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

11. *Venenarius malodorus* Murrill. 1945. Jour. Flor. Acad. Sci. 8(2): 183.
≡ *Amanita malodora* (Murr.) Murrill. 1945. Jour. Flor. Acad. Sci. 8(2): 198.

Holotype: Gainesville, Florida, 11. viii. 1944, W. A. Murrill 32707 (FLAS).

PILEUS: 50 mm broad, plano-convex, margin non-striate, *rosy-isabelline*; volval remnants as randomly scattered patches. LAMELLAE: adnexed, very crowded, *white with slight pinkish tint*. STIPE: up to 105 x 3-7 mm, tapering upward, slightly expanded at apex, solid, *white*, basal bulb subglobose, only slightly broader than stipe base; annulus superior, delicately membranous; volval remnants as a very few floccose-membranous patches remaining at apex of basal bulb.

PILEIPELLIS: filamentous hyphae interwoven to subradial 3-8 μm diam, only very slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae inflated ramose to subcellular no clamps. BASIDIA: up to 40 x 3-11 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus conspicuous, moderately branched, up to 8 µm diam; inflated cells mostly elongate, fusiform to clavate with occasional broadly elliptic, up to 115 x 35 µm, terminal or short, terminal chains: volval material at base of stipe very similar to that on pileus. STIPE TRAMA: filamentous hyphae conspicuous, sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 250 x 18.8 µm. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, up to 8 µm diam, no clamps; inflated cells numerous, clavate to fusiform, terminal, up to 125 x 15 µm.

SPORES: 6.2-7.0 x 7.0-7.8 µm ($\underline{E}$ = 1.13-1.26; $\underline{E^m}$ = 1.14), subglobose to broadly elliptic, often adaxially flattened, hyaline, weakly amyloid, thin walled; contents guttulate, apiculus sublateral, truncate-conic.

Bas (1969) has placed this taxon in synonymy with *Amanita praegraveolens*.

12. *Venenarius mappa* var. *tenuipes* (Fr.) Murrill. 1948. Lloydia 2(2): 104.
≡ *Amanita mappa* var. *tenuipes* (Fr.) Murrill. 1948. Lloydia 2(2): 105.

Holotype: Fairbanks, Alachua Co., Florida, 29. xii. 1945, G. F. Weber 15454(FLAS).

PILEUS: 55 mm broad, plane, margin non-striate, *pale-citrinous*; volva as very thin, floccose crusts, randomly distributed. LAMELLAE: just free, crowded. STIPE: 90 x 3 mm, cylindric, slightly expanded at apex, solid, *white with cream scales below*, basal bulb globose, 26 x 26 mm; no annulus remaining; volva as shallow, membranous patches on bulb apex.

PILEIPELLIS: filamentous hyphae interwoven, up to 8 µm diam, gelatinized. PILEUS TRAMA: considerable filamentous hyphae and elongate, inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae inflated ramose to subcellular, no clamps. BASIDIA: up to 50 x 4-11 µm, 4-sterigmate, very distinctive, like horns, no clamps. VOLVA: filamentous hyphae on pileus sparse, moderately branched, up to 7 µm diam, no clamps; inflated cells dominant, terminal chains, subglobose, broadly elliptic to ovoid, up to 94 x 78.5 µm, with a few fusiform and clavate, up to 71 x 15 µm: volval material at base of stipe mostly filamentous hyphae, interwoven, with a few inflated cells. STIPE TRAMA: filamentous hyphae sparsely branched, moderately conspicuous, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 345 x 35 µm.

SPORES: 7.0-8.6 x 7.8-8.6 µm ($\underline{E}$ = 1.00-1.11; $\underline{E^m}$ = 1.03), globose to subglobose, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindrical.

13. *Venenarius margarita* Murrill. 1945. Mycologia 37(2): 270.
≡ *Amanita margarita* (Murr.) Murrill. Mycologia 37(2): 271.

Holotype: Gainesville, Florida, 28. vi. 1944, W. A. Murrill 38906(FLAS).

PILEUS: up to 50 mm broad, convex to plano-convex, shiny, margin non-striate, *dull white with an avellaneous tint*; volva as a membranous patch, usually on disc. LAMELLAE: free, crowded, *white*. STIPE: up to 40 x 7 mm, cylindric, slightly expanded at apex, solid, *white*, basal bulb subradicate; annulus thin, membranous, apical, pendant, *white*; volva membranous, saccate, slightly lobed, about 15 mm deep, very sturdy, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 2-7 µm diam, only slightly gelatinized. PILEUS TRAMA: inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae slightly inflated ramose, no clamps. BASIDIA: up to 43 x 4-9.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus dominant, moderately branched, up to 8 µm diam, no clamps; inflated cells conspicuous, subglobose, broadly elliptic, elliptic and clavate, up to 63 x 31 µm: volval material at base of stipe slightly layered; outer layer mostly filamentous hyphae, moderately branched, up to 11.8 µm, no clamps; inflated cells few, mostly clavate, terminal, up to 156 x 21 µm, with very few broadly elliptic, up to 31 x 21 µm; inner layer with greater number of inflated cells, terminal, up to 93 x 61 µm; filamentous hyphae up to 9 µm diam, many gelatinized. STIPE TRAMA: filamentous hyphae moderately conspicuous, sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 218 x 61 µm. PARTIAL VEIL: completely filamentous hyphae, moderately branched, interwoven, up to 6 µm diam, no clamps.

SPORES: 5.0-5.5 x 12.5-14.8 µm ($\underline{E}$ = 2.42-2.82; $\underline{E}^{m}$ = 2.59), cylindrical, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, truncate-conic.

14. *Amanita neglecta* Murrill. 1955. Mycologia 47(3): 427.

Holotype: Gainesville, Florida, 16. ix. 1950, W. A. Murrill 32887 (FLAS).

PILEUS: 32 mm broad, plano-convex, margin slightly incurved, appendiculate, non-striate, *white*; volval remnants as slight flocculence covering most of pileus. LAMELLAE: narrowly adnexed, crowded, *white*. STIPE: 60 x 8 mm, tapering slightly upward, apex expanded, solid, *white*; annulus superior, only a few remnants remaining, *white*; volval remnants absent.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 µm diam, very slightly gelatinized. PILEUS TRAMA: filamentous hyphae dominant, inflated cells elongate, large number of gloeoplerous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: unable to reinflate. BASIDIA: up to 47 x 3.5-11 µm, 4-sterigmate. VOLVA: filamentous hyphae on pileus inconspicuous, moderately branched, up to 8 µm diam, no clamps; inflated cells dominant, terminal or short, terminal chains, mostly elliptic to clavate with very few broadly elliptic, up to 94 x 31 µm: volval material at base of stipe absent. STIPE TRAMA: filamentous hyphae inconspicuous, sparsely branched, up to 7 µm diam, no clamps. PARTIAL VEIL: difficult to reinflate; mostly filamentous hyphae with a few inflated cells.

SPORES: 3.9-5.5 x 8.6-10.2 µm ($\underline{E}$ = 1.85-2.21; $\underline{E}^{m}$ = 2.00), elongate to cylindric, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

15. *Venenarius odoriferus* Murrill. 1943. Mycologia 35(4): 427-428.
≡ *Amanita odorifera* (Murr.) Murrill. 1943. Mycologia 35(4): 433.

Holotype: Sugarfoot, near Gainesville, Florida, 11. vii. 1938, West, Arnold, and Murrill 17684(FLAS).

PILEUS: up to 105 mm broad, plano-convex, margin non-striate, appendiculate, slightly incurved, glabrous, *white*; volval remnants as floccose-mealy material covering most of pileus in younger specimens. LAMELLAE: free, moderately close, *white*. STIPE: up to 80 x 11 mm, subcylindric, solid, *white*, basal bulb globose to subglobose, up to 35 x 35 mm; annulus evanescent, floccose, adhering to lamellae, *white*; volval remnants as floccose-mealy material on bulb.

PILEIPELLIS: filamentous hyphae mostly decomposed into gelatinous matrix. PILEUS TRAMA: elongate, inflated cells, and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae inflated ramose, no clamps. BASIDIA: up to 46 x 3-9 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae very inconspicuous, sparsely branched, up to 7 µm diam, no clamps; inflated cells dominant, subglobose, ovoid, broadly elliptic, elliptic, clavate, pyriform, up to 68 x 49 µm, terminal and short, terminal chains: volval material at base of stipe very similar to that on pileus. STIPE TRAMA: filamentous hyphae very conspicuous, moderately branched, up to 9 µm diam, no clamps; inflated cells terminal with few very short, terminal chains, clavate, longitudinally oriented, up to 157 x 22 µm. PARTIAL VEIL: almost completely inflated cells, subglobose, broadly elliptic, pyriform, oblong-elliptic, clavate, up to 31 x 29 µm; filamentous hyphae very inconspicuous, up to 7 µm diam.

SPORES: 6.3-7.8 x 10.2-11.7 µm ($\underline{E}$ = 1.40-1.86; $\underline{E^m}$ = 1.63), elliptic to elongate, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short, cylindric.

Bas (1969) has placed this taxon in synonymy with *Amanita polypyramis* (Berk. & Curt.) Sacc.

16. *Venenarius pantherinoides* Murrill. 1912. Mycologia 4(5): 242-243.
≡ *Amanita pantherinoides* (Murr.) Murrill. 1912. Mycologia 4(5): 262.

Holotype: Seattle, Washington, 20. x. - 1. xi. 1911, W. A. Murrill 399(NY).

PILEUS: up to 45 mm broad, convex to plane, margin not striate, *melleous or dirty-cremeous with brown or chestnut center*; volval remnants as thin, floccose patches, *white*. LAMELLAE: free, crowded, *white*. STIPE: up to 70 x 7 mm, tapering slightly upward, apex expanded, stuffed, *white*; volval remnants as small, free margin and occasional floccose material at apex of basal bulb, *white*.

PILEIPELLIS: filamentous hyphae densely interwoven, 3-8 µm diam, gelatinized. PILEUS TRAMA: filamentous hyphae undifferentiated, up to 7 µm diam; inflated cells clavate to irregularly elongate, up to 160 x 32 µm. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, rarely clamped. BASIDIA: up to 47 x 4.5-11 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus conspicuous, moderately branched, up to 8 µm diam, no clamps; inflated cells terminal or short, terminal chains, subglobose, ovoid, broadly elliptic, elliptic, oblong-elliptic, clavate, up to 83 x 58 µm: filamentous hyphae at base of stipe up to 7 µm diam, moderately branched, no clamps; inflated cells terminal or short, terminal chains, primarily clavate to oblong-elliptic, with fewer broadly elliptic to ovoid, up to 105 x 38 µm. STIPE TRAMA: filamentous hyphae inconspicuous, sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 286 x 32 µm. PARTIAL VEIL: filamentous hyphae moderately branched, up to 6 µm diam, rarely clamped; inflated cells terminal, clavate to elliptic, up to 130 x 25 µm.

SPORES: 6.3-7.9 x 7.0-9.4 µm ($\underline{E}$ = 1.11-1.38; E^m = 1.20), subglobose to elliptic, often adaxially flattened, hyaline, non-amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

Jenkins (1977) has reduced this to a variety of *Amanita pantherina*, i.e., *Amanita pantherina* var. *pantherinoides*.

17. *Venenarius parviformis* Murrill. 1944. Lloydia 7(4): 315.
≡ *Amanit parviformis* (Murr.) Murrill. 1944. Lloydia 7(4): 327.

Holotype: Gainesville, Florida, 4. x. 1943, W. A. Murrill 19266(FLAS).

PILEUS: up to 25 mm broad, plano-convex, margin slightly incurved, very slightly striate, *white*; volval remnants as thin, floccose-membranous patches on disc. LAMELLAE: free, moderately crowded, *white*. STIPE: 25 x 3 mm, cylindric, solid, *white*, basal bulb subglobose, *white*; annulus superior, membranous, pendant, *white*; volval remnants membranous, saccate, slightly lobed, sturdy.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 2-8 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae probably ramose (poor reinflation). BASIDIA: up to 46 x 4-13 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae dominant, moderately branched, up to 8 µm diam, no clamps; inflated cells few, terminal, broadly elliptic to elliptic, up to 93 x 63 µm: volval material at base of stipe very similar to that on pileus. STIPE TRAMA: filamentous hyphae moderately conspicuous, sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 187 x 28 µm. PARTIAL VEIL: exclusively filamentous hyphae, moderately branched, up to 7 µm diam, no clamps.

SPORES: 5.5-6.3 x 7.8-9.4 µm ($\underline{E}$ = 1.24-1.54; $\underline{E}^m$ = 1.40), broadly elliptic to elliptic, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindrical.

18. *Venenarius parvus* Murrill. 1945. Proc. Fla. Acad. Sci. 7: 114.
≡ *Amanita parva* (Murr.) Murrill. 1945. Proc. Fla. Acad. Sci. 7: 127.

Holotype: Gainesville, Florida, 21. vi. 1938, W. A. Murrill 17404 (FLAS).

PILEUS: 20 mm broad, plane, margin non-striate, *white*; volval remnants as a few randomly distributed, floccose patches. LAMELLAE: narrowly adnexed, moderately crowded, *pallid*. STIPE: 30 x 2 mm, cylindric, apex slightly expanded, solid, *white*, basal bulb abruptly marginate, napiform, *white*; annulus apical, submembranous; volval remnants as a very shallow, submembranous cup at apex of basal bulb.

PILEIPELLIS: filamentous hyphae interwoven, 2-7 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, clamped. BASIDIA: up to 40 x 5.5-10 µm, 4-sterigmate, clamped. VOLVA: filamentous hyphae on pileus conspicuous, moderately branched, up to 7 µm diam, clamps occasional; inflated cells terminal or short, terminal chains, globose, subglobose, broadly elliptic, clavate to fusiform, up to 65 x 65 µm: volval material at base of stipe very similar to that on pileus. STIPE TRAMA: filamentous sparsely branched, moderately conspicuous, up to 8 µm diam, clamps occasional; inflated cells terminal, clavate, longitudinally oriented. PARTIAL VEIL: filamentous hyphae moderately branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, up to 31 x 16 µm.

SPORES: 4.7-5.5 x 10.2-10.9 µm ($\underline{E}$ = 1.85-2.32; $\underline{E}^{m}$ = 2.03), elongate to cylindric, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, truncate-conic to short cylindrical.

19. *Venenarius praegemmatus* Murrill. 1912. Mycologia 4(5): 243.
≡ *Amanita praegemmata* (Murr.) Murrill. 1912. Mycologia 4(5): 262.

Holotype: Seattle, Washington, 20. x. - 1. xi. 1911, W. A. Murrill 247(NY).

PILEUS: approximately 40 mm broad, convex to plano-convex, margin non-striate, *melleous-avellaneous in the center, dark-melleous on the margin*; volval remnants as *white*, floccose-fibrillose patches or occasionally angular warts covering most of pileus. LAMELLAE: free, crowded, *white*. STIPE: 40 x 3-5 mm, tapering slightly upward, stuffed, *white*, basal bulb ovoid, annulus superior, slightly, *white*; volval remnants appressed, as slight free margin on basal bulb.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, occasionally clamped. BASIDIA: up to 47 x 4.5-12.5 µm, 4-sterigmate, occasionally clamped. VOLVA: filamentous hyphae moderately branched, 3-8 µm diam; inflated cells terminal or short, terminal chains, irregularly disposed to apico-basal, globose, subglobose, ovoid, broadly elliptic, up to 64 x 45 µm, and clavate, elliptic, to oblong-elliptic, up to 115 x 38 µm: filamentous hyphae of volva at base of stipe very similar to that on pileus; inflated cells primarily elongate to clavate, up to 127 x 31 µm, with a few small, broadly elliptic to ovoid. STIPE TRAMA: filamentous hyphae moderately conspicuous, sparsely branched, up to 7 µm diam; inflated cells terminal, clavate, longitudinally oriented, up to 221 x 35 µm. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, 3-7 µm diam, rarely clamped; inflated cells sparse, clavate, up to 125 x 20 µm.

SPORES: 6.3-7.0 x 8.7-9.4 µm ($\underline{E}$ = 1.34-1.49; $\underline{E}^{m}$ = 1.43), elliptic, often adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical to truncate-conic.

Jenkins (1977) has reduced this to synonymy with *Amanita pantherina* var. *pantherinoides*.

20. *Lepiota praegraveolens* Murrill. 1939. Bull. Torr. Bot. Club 66: 153.
≡ *Amanita praegraveolens* (Murr.) Singer. 1949. Lilloa 22: 388.

Holotype: Gainesville, Florida, 25. x. 1938, W. A. Murrill 18298 (FLAS).

PILEUS: 70 mm broad, plano-convex, margin slightly incurved, non-striate, *white*; no volval remnants remaining. LAMELLAE: free, very crowded, *white*. STIPE: up to 80 x 8 mm, subcylindric, solid, apex slightly expanded, *white*; annulus superior, evanescent, floccose, *white*; no volval remnants remaining.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-7 μm diam. PILEUS TRAMA: filamentous hyphae and inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae subcellular to cellular, no clamps. BASIDIA: up to 40 x 4-10 μm, 4-sterigmate, no clamps. VOLVA: no remnants remaining on pileus or stipe base. STIPE TRAMA: filamentous hyphae moderately abundant, sparsely branched, up to 11 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 301 x 40 μm.

SPORES: (6.2)7.0-7.8 x (6.2) 7.8-8.6 μm ($\underline{E}$ = 1.0-1.11; $\underline{E}^m$ = 1.04), globose to subglobose, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

21. *Venenarius praelongisporus* Murrill. 1941. Mycologia 33(4): 434-435.
≡ *Amanita praelongispora* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Gainesville, Florida, 16. v. 1938, W. A. Murrill 16108 (FLAS).

PILEUS: up to 60 mm broad, plano-convex, glabrous-shiny, margin slightly incurved, slightly appendiculate, non-striate, *white or with faint cream tint*. LAMELLAE: free, crowded, *white*. STIPE: up to 55 x 8 mm, subcylindric, solid, *white with a yellowish tint*, basal bulb subglobose to ovoid; annulus evanescent, delicate membranous, adhering to lamellae, *white*; volval remnants as a few floccose patches, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 2-7 μm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 50 x 4-10 μm, 4-sterigmate, clamped. VOLVA: filamentous hyphae of volva at stipe base moderately branched, up to 7 μm diam, no clamps; inflated cells dominant, terminal or short, terminal chains, ovoid, broadly elliptic, up to 63 x 47 μm and fusiform up to 110 x 47 μm. STIPE TRAMA: filamentous hyphae sparsely branched, up to 7 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 358 x 38 μm. PARTIAL VEIL: filamentous hyphae moderately branched, up to 5 μm diam, no clamps; inflated cells abundant, broadly elliptic, ovoid, subglobose, up to 40 x 40 μm, with fusiform to clavate, up to 218 x 37 μm.

SPORES: 4.7-5.5 x (10.2)10.9-11.7(14.1) μm ($\underline{E}$ = 1.98-2.56; $\underline{E}^m$ = 2.34), elongate to cylindric, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

22. *Venenarius pseudovernus* Murrill. 1944. Proc. Fla. Acad. Sci. 7: 114-115.
≡ *Amanita pseudoverna* (Murr.) Murrill. 1944. Proc. Fla. Acad. Sci. 7: 127.

Holotype: Gainesville, Florida, 29. v. 1938, W. A. Murrill 16431 (FLAS).

PILEUS: up to 40 mm broad, plano-convex, margin slightly incurved, non-striate, *pure white throughout or with cream disc.* LAMELLAE: free, crowded. STIPE: up to 65 x 8 mm, subcylindric, solid, *white*, basal bulb ovoid; annulus submembranous, easily torn, superior, *white*; volval remnants as membranous, saccate, lobed, relatively thick, *white.*

PILEIPELLIS: filamentous hyphae interwoven, 2-6 μm diam, gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, no clamps. VOLVA: remnants at base of stipe layered; outer layer composed exclusively of densely interwoven, filamentous hyphae, moderately branched, up to 12 μm diam, no clamps; inner layer very similar, but not as densely interwoven. STIPE TRAMA: filamentous hyphae abundant, sparsely branched, up to 7 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 140 x 16 μm. PARTIAL VEIL: filamentous hyphae abundant, interwoven, moderately branched, no clamps; inflated cells small, irregularly shaped, terminal.

SPORES: 7.0-7.8 x 7.8-8.6(10.2) μm ($\underline{E}$ = 1.11-1.31; $\underline{E}^m$ = 1.22), subglobose to elliptic, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, truncate-conic.

23. *Venenarius rhoadsii* Murrill. 1939. Bull. Torr. Bot. Club 66: 30.
≡ *Amanita rhoadsii* (Murr.) Murrill. 1939. Bull. Torr. Bot. Club 66: 37.

Holotype: Lake Rosa, Putnam Co., Florida, 8. ix. 1938, A. S. Rhoads 18125(FLAS).

PILEUS: up to 65 mm broad, plano-convex, margin non-striate, inrolled, *white, cremeous on drying*; pileus densely covered with loose, floccose, volval material. LAMELLAE: free, distant, *white, becoming brown when dried.* STIPE: up to 145 x 18 mm, subcylindric, solid, *white, cremeous when dried*, basal bulb slenderly fusiform to napiform; annulus evanescent, strongly floccose, *white*; volva as a few floccose patches.

PILEIPELLIS: filamentous hyphae interwoven, 3-6 μm diam, slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, clamps rare. BASIDIA: up to 50 x 4-11.7 μm, 4-sterigmate, clamped. VOLVA: filamentous hyphae on pileus conspicuous, moderately branched, up to 7 μm diam; inflated cells terminal or short, terminal chains, globose, elliptic, oblong-elliptic, pyriform, clavate, fusiform, up to 120 x 60 μm, primarily apico-basal; volval material at base of stipe similar to that on pileus. STIPE TRAMA: filamentous hyphae sparsely branched, up to 7 μm diam, few clamps; inflated cells terminal, clavate, longitudinally oriented, up to 258 x 27 μm.

SPORES: 3.1-3.9 x 10.9-12.5 μm ($\underline{E}$ = 2.70-3.77; $\underline{E}^m$ = 3.24), cylindrical to bacilliform, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

24. *Venenarius roanokensis* f. *inodora* (Coker) Murrill. 1946. Lloydia 9(4): 324.

≡ *Amanita roanokensis* f. *inodora* (Coker) Murrill. 1946. Lloydia 9(4): 330.

≡ *Amanita inodora* (Murr.) Bas. 1969. Persoonia 5(4): 547-548.

Holotype: Gainesville, Florida, 29. viii. 44, W. A. Murrill 20091 (FLAS).

PILEUS: up to 45 mm broad, plano-convex, margin slightly raised, non-striate; no volval remnants. LAMELLAE: free or connected by floccose line, moderately close, STIPE: up to 30 x 5 mm, cylindric, solid, slightly expanded at apex, glabrous or with slightly floccose, material, basal bulb marginate, ovoid to subradicate, up to 20 x 15 mm; annulus floccose-membranous, evanescent; only slight, floccose volval material remaining.

PILEIPELLIS: filamentous hyphae interwoven, up to 7 µm diam, gelatinized. PILEUS TRAMA: filamentous hyphae undifferentiated with broadly clavate to fusiform inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: ramose to slightly inflated ramose, no clamps. BASIDIA: up to 45 x 4-8 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus very sparse, sparsely branched, up to 6 µm diam, no clamps; inflated cells dominant, mostly terminal chains, broadly elliptic to ovoid, up to 50 x 28 µm, with fewer oblong-elliptic to clavate, up to 63 x 25 µm: volval material at base of stipe very similar, but with inflated cells slightly smaller. STIPE TRAMA: filamentous hyphae sparsely branched, inconspicuous, up to 6 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented; considerable gloeoplerous hyphae present. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, up to 6 µm diam, no clamps; inflated cells terminal, clavate, up to 38 x 12 µm.

SPORES: 3.9-4.7 x 12.5-13.3(14.1) µm ($\underline{E}$ = 2.66-3.41; $\underline{E}^m$ = 2.94), cylindrical to bacilliform, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short, truncate-conic.

25. *Venenarius roseitinctus* Murrill. 1914. North American Flora 10(1): 75.

≡ *Amanita roseitincta* (Murr.) Murrill. 1914. Mycologia 6: 269.

Holotype: Biloxi, Mississippi, 13. ix. 1904, Mrs. F. S. Earle 182(NY).

PILEUS: 35 mm broad, convex, margin non-striate, slightly incurved, *salmon colored*; volval remnants as pulverulent meal over most of surface. LAMELLAE: free, crowded, *white*. STIPE: 60 x 5-8 mm, tapering upward, apex slightly expanded, stuffed, *white tinged with salmon*, basal bulb elliptic, 20 x 12 mm; annulus membranous, delicate, remaining attached to gills and pileus margin, *white tinged with salmon*; volval remnants as a slightly, mealy material on apex of bulb, *salmon colored*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-6 µm diam, slightly gelatinized. PILEUS TRAMA: undifferentiated, filamentous hyphae and inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae inflated ramose to subcellular, no clamps. BASIDIA: up to 54 x 4-12 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus conspicuous, moderately branched, up to 6 µm diam, no clamps; inflated cells terminal or short, terminal chains, mostly globose to broadly elliptic, up to 46 x 46 µm: volval material at base of stipe predominantly filamentous hyphae, moderately branched, up to 8 µm diam, no clamps; inflated cells short, terminal chains, globose, subglobose, broadly elliptic, up to 35 x 35 µm, with subtending cells elliptic to fusiform, up to 45 x 15 µm. STIPE TRAMA: filamentous hyphae sparsely branched, up to 5 µm diam, no clamps; inflated cells terminal, clavate. PARTIAL VEIL: almost completely filamentous hyphae, moderately branched, up to 7 µm diam, no clamps; inflated cells few, terminal, short clavate.

SPORES: none found.

26. *Venenarius solitariiformis* Murrill. 1941. Mycologia 33(4): 435.
≡ *Amanita solitariiformis* (Murr.) Murrill. 1941. Mycologia 33 (4): 448.

Holotype: Gainesville, Florida, 9. viii. 1937, W. A. Murrill 16415 (FLAS).

PILEUS: 42 mm broad, plano-convex, margin non-striate, slightly incurved, *white stained with cream*; volval remnants as pyramidal to irregularly shaped warts, easily removed. LAMELLAE: free, moderately close, *white to isabelline with white edges*. STIPE: 25 x 6-8 mm, tapering slightly upward, solid, *white*, basal bulb nearly subradicate; volval remnants as pulverulence covering most of stipe surface and basal bulb.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, slightly gelatinized. PILEUS TRAMA: filamentous hyphae moderately branched, up to 8 µm diam; inflated cells mostly clavate, up to 218 x 40 µm. LAMELLA TRAMA: bilateral. SUBHYMENIUM: ramose to inflated ramose, no clamps. BASIDIA: up to 60 x 4-11.7 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae quite inconspicuous, moderately branched, up to 8 µm diam, no clamps; inflated cells dominant, terminal and short, terminal chains, globose, subglobose, broadly elliptic, ovoid, elliptic, and clavate, up to 40 x 35 µm: volval material at base of stipe very similar, but with fewer hyphae than on pileus. STIPE TRAMA: filamentous hyphae sparsely branched, moderately abundant, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 188 x 31 µm.

SPORES: 4.7-5.5 x (12.5)13.3-14.1(15.6) µm ($\underline{E}$ = 2.42-3.00; $\underline{E}^{m}$ = 2.69), cylindrical, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus, short, cylindrical.

27. *Venenarius spretellus* Murrill. 1948. Lloydia 2(2): 105.
≡ *Amanita spretella* (Murr.) Murrill. 1948. Lloydia 2(2): 105.

Holotype: Gainesville, Florida, 19. viii. 1948, W. A. Murrill 40841 (FLAS).

PILEUS: 33 mm broad, plane, margin distinctly striate, *gray, darker on disc*; no volval remnants remaining. LAMELLAE: just free, crowded, *white*. STIPE: 70 x 4-6 mm, tapering slightly upward, stuffed to hollow, *white above, lower half delicate rosy-cream*, no basal bulb; no annulus; volva saccate, membranous, *white*, lobed.

PILEIPELLIS: filamentous interwoven, 3-7 µm diam, gelatinized.

PILEUS TRAMA: filamentous hyphae and elongate, inflated cells, terminal or short, terminal chains. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 45.8 x 3.9-12.5 µm, 4-sterigmate, no clamps. VOLVA: no remnants on pileus: volval material at base of stipe predominantly filamentous hyphae, moderately branched, up to 7 µm diam, no clamps; inflated cells few, elongate, terminal, up to 34 x 8 µm. STIPE TRAMA: filamentous hyphae moderately branched, moderately conspicuous, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 244 x 40 µm.

SPORES: (6.7)7.0-7.8 x 11.7-13.3 µm ($\underline{E}$ = 1.50-1.88; $\underline{E}^m$ = 1.66), elliptic to elongate, often adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

28. *Venenarius suballiaceus* Murrill. 1941. Mycologia 33(4): 437-438.
≡ *Amanita suballiacea* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Gainesville, Florida, 22. vi. 1938, W. A. Murrill 16495 (FLAS).

PILEUS: approximately 20 mm broad, plano-convex, margin nonstriate, *white*; no volval remnants. LAMELLAE: free, crowded, *white*. STIPE: up to 75 x 2-4 mm, slightly expanded at apex, solid, *white*, basal bulb ovoid; annulus superior, membranous, fairly delicate, *white*; volval remnants as one membranous patch at apex of bulb.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, slightly gelatinized. PILEUS TRAMA: filamentous hyphae and inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: ramose to slightly inflated ramose, no clamps. BASIDIA: up to 58.5 x 4-10.5 µm, 4-sterigmate, no clamps. VOLVA: remnants at base of stipe completely filamentous hyphae, moderately branched, up to 6.5 µm diam, no clamps. STIPE TRAMA: filamentous hyphae sparsely branched, relatively inconspicuous, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 274 x 37 µm. PARTIAL VEIL: mostly filamentous hyphae, moderately branched, up to 6 µm diam, no clamps; inflated cells numerous, terminal, subglobose to ovoid, up to 16 x 16 µm.

SPORES: 5.9-7.0 x 11.7-14.1 µm ($\underline{E}$ = 1.66-2.27; $\underline{E}^m$ = 1.98),elongate to cylindric, often adaxially flattened, hyaline, weakly amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindric.

29. *Venenarius subcitriniceps* Murrill. 1945. Jour, Fla. Acad. Sci. 8(2): 183-184.
≡ *Amanita subcitriniceps* (Murr.) Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 198.

Holotype: Gainesville, Florida, 30. vi. 1944, W. A. Murrill 38901 (FLAS).

PILEUS: approximately 29 mm broad, plano-convex, margin nonstriate, *pale citrinous*; no volval remnants remaining. LAMELLAE: narrowly adnate, crowded, *white*. STIPE: 60 x 2-5 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb elliptic, *white*; exannulate; volva as a few floccose patches on lower part of stipe.

PILEIPELLIS: filamentous hyphae interwoven, 3-8 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to inflated ramose, no clamps. BASIDIA: up to 40 x 4-8.5 µm, 4-sterigmate, no clamps. VOLVA: poor reinflation. STIPE TRAMA: filamentous hyphae sparsely branched, moderately abundant, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 212 x 34 µm.

SPORES: 5.5-6.2 x 7.8-8.6(9.4) µm ($\underline{E}$ = 1.39-1.52; $\underline{E}^m$ = 1.43), elliptic, often adaxially flattened, hyaline, extremely weakly amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindric.

30. *Venenarius submutabilis* Murrill. 1943. Mycologia 35(4): 428.
≡ *Amanita submutabilis* (Murr.) Murrill. 1943. Mycologia 35(4): 433.

Holotype: Burnett's Lake, Alachua Co., Florida, 24. ix. 1941, W. A. Murrill 20004(FLAS).

PILEUS: up to 70 mm broad, plano-convex, margin non-striate, slightly incurved, *white*; volval remnants as a thin layer of pulverulence, easily removed. LAMELLAE: free, moderately crowded, *white*. STIPE: up to 60 x 8 mm, apex slightly expanded, solid, *white*, basal bulb subglobose to ovoid; annulus superior, floccose-membranous, *white*; volval remnants membranous, thick, forming shallow cup at top of bulb, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 63 x 6.5-10.5 µm, 4-sterigmate, clamps rare. VOLVA: filamentous hyphae on pileus dominant, moderately branched, up to 8 µm diam, no clamps; inflated cells conspicuous, mostly elliptic to clavate, terminal, up to 132 x 47 µm, few ovoid: volval material at base of stipe very similar to that on pileus, but with larger number of broadly elliptic to ovoid cells. STIPE TRAMA: filamentous hyphae moderately conspicuous, sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 306 x 47 µm. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, up to 8 µm diam, no clamps; inflated cells few, slenderly clavate, terminal.

SPORES: 6.2-7.8 x 13.3-14.1(14.8) µm ($\underline{E}$ = 1.81-2.15; $\underline{E}^m$ = 1.98), elongate to cylindric, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

Bas (1969) has placed this taxon into synonymy with *Amanita mutabilis* Beardslee.

31. *Venenarius subphalloides* Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 184.
≡ *Amanita subphalloides* (Murr.) Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 198.

Holotype: Gainesville, Florida, 11. vii. 1938, Lillian Arnold 17832 (FLAS).

PILEUS: 25 mm broad, plano-convex, margin non-striate, *umbrinous with fuliginous disk*; volval remnants as randomly distributed floccose patches. LAMELLAE: free, crowded, *white with a rosy tint*.

Stipe: 35 x 2 mm, solid, *white*, *blushing where bruised*, basal bulb subglobose, *white*; annulus superior, delicate, membranous, *white*; volval remnants as a few floccose-membranous patches on apex of basal bulb.

PILEIPELLIS: filamentous hyphae interwoven, 3-8 μm diam, gelatinized. PILEUS: elongate, inflated cells and undifferentiated, filamentous hyphae, no clamps. LAMELLA TRAMA: bilateral. SUBHYMENIUM: inflated ramose to subcellular, no clamps. BASIDIA: up to 32 x 4-8.5 μm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus moderately abundant, moderately branched, up to 8 μm diam, clamps; inflated cells terminal or short, terminal chains, globose, subglobose, broadly elliptic, ovoid, up to 40 x 40 μm, with few fusiform and clavate: volval material at base of stipe very similar, but with slightly larger cells, up to 55 x 55 μm. STIPE TRAMA: filamentous hyphae sparsely branched, relatively inconspicuous, up to 7 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 212 x 34.5 μm.

SPORES: 5.5-6.2(7.4) x 5.5-7.0(7.8) μm ($\underline{E}$ = 1.0-1.13; $\underline{E^m}$ = 1.07) globose to subglobose, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

32. *Venenarius subrecutitus* Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 184.
≡ *Amanits subrecutita* (Murr.) Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 198.

Holotype: Gainesville, Florida, 26. iii. 1944, W. A. Murrill 17996 (FLAS).

PILEUS: approximately 40 mm broad, plane with margins upturned, shiny, margin striate, *avellaneous*; no volval remnants. LAMELLAE: narrowly adnate, crowded, *white*. STIPE: up to 60 x 4-6 mm, stuffed to hollow, *white*, basal bulb elliptical; no annular remnants; volval remnants as a membranous, shallow cup, *white*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-6 μm diam, gelatinized. PILEUS TRAMA: inflated cells and undifferentiated filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: unable to reinflate. BASIDIA: up to 40 x 4-7.8 μm, 4-sterigmate, no clamps. VOLVA: unable to reinflate. STIPE TRAMA: filamentous hyphae sparsely branched, up to 8 μm diam, no clamps; inflated cells terminal, elliptic to fusiform, longitudinally oriented, up to 190 x 47 μm.

SPORES: 7.0-8.6 x 12.5-13.3 μm ($\underline{E}$ = 1.54-1.90; $\underline{E^m}$ = 1.75), elliptic to elongate, often adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

33. *Venenarius subsolitarius* Murrill. 1941. Mycologia 33(4): 435.
≡ *Amanita subsolitaria* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Gainesville, Florida, 1. vi. 1938, W. A. Murrill 16449 (FLAS).

PILEUS: up to 55 mm broad, convex, margin non-striate, slightly incurved, *white or rosy-isabelline*; volval remnants as a few floccose warts, randomly distributed, densest near center. LAMELLAE: narrowly adnate, crowded, *white*. STIPE: up to 75 x 6-9 mm, slightly expanded at apex, solid, *white*, basal bulb elliptical; annulus fugacious, only a few floccose remnants remaining; volval remnants as a very slight flocculence, easily removed.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 μm diam, slightly gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: ramose to inflated ramose, no clamps. BASIDIA: up to 50 x 4-13.5 μm, 4-sterigmate, rarely clamped. VOLVA: filamentous hyphae on pileus moderately branched, up to 8 μm diam, no clamps; inflated cells as terminal chains, globose, subglobose, broadly elliptic, pyriform, up to 55 x 40 μm: volval remnants at base of stipe very similar to that on pileus. STIPE TRAMA: filamentous hyphae conspicuous, sparsely branched, up to 7 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 290 x 31 μm. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, up to 7 μm diam, no clamps; inflated cells terminal, oblong elliptic to clavate, up to 47 x 10 μm.

SPORES: (4.7)5.0-5.5 x (10.9)11.7-12.8(13.3) μm ($\underline{E}$ = 2.20-2.66; $\underline{E}^m$ = 2.36), cylindrical, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindrical.

34. *Venenarius subvirginianus* Murrill. 1941. Mycologia 33(3): 286.
≡ *Amanita subvirginiana* (Murr.) Murrill. 1941. Mycologia 33(3): 287.

Holotype: Gainesville, Florida, 27. iii. 1938, W. A. Murrill 16134 (FLAS).

PILEUS: 10 mm broad, plane, margin distinctly striate, *avellaneous*; volval remnant as one floccose-membranous patch on disc. LAMELLAE: free, subdistant, *white*. STIPE: 27 x 1-2 mm, stuffed, *milk-white*, basal bulb very slight; annulus superior, nearly median, delicately membranous, *white*; volval remnants membranous, saccate, thin, *white*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 μm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: inflated ramose to subcellular, clamps rare. VOLVA: filamentous hyphae dominant, up to 8 μm diam, moderately branched, clamps; inflated cells mostly terminal, broadly elliptic, elliptic, cylindric, up to 93 x 46 μm: volval material at base of stipe very similar, but with more filamentous hyphae and fewer inflated cells. STIPE TRAMA: filamentous hyphae sparsely branched, up to 6 μm diam, no clamps; inflated cells terminal or short, terminal chains, oblong elliptic, longitudinally oriented, up to 291 x 47 μm. PARTIAL VEIL: completely filamentous hyphae, moderately branched, up to 7 μm diam, no clamps.

SPORES: 7.8-9.4 x 10.2-11.7(12.5) μm ($\underline{E}$ = 1.24-1.43; $\underline{E}^m$ = 1.35), broadly elliptic to elliptic, often adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

Singer (1949) has placed this in synonymy with *Amanita spreta* var. *minor* Beardslee.

35. *Venenarius tenuifolius* Murrill. 1945. Mycologia 37(2): 270.
≡ *Amanita tenuifolia* (Murr.) Murrill. 1945. Mycologia 37(2): 271.

Holotype: Gainesville, Florida, 22. vi. 1944, W. A. Murrill 38002 (FLAS).

PILEUS: up to 35 mm broad, plano-convex, margin non-striate, *white, becoming yellowish on the disk with age or on drying*; no volval remnants. LAMELLAE: just free or narrowly adnexed, crowded, *white*. STIPE: up to 55 x 4-6 mm, tapering slightly upward, apex expanded, solid, *white*, basal bulb ovoid; annulus superior, thin, membranous, *white*; volval remnants as thin, membranous cup at apex of bulb, lobed, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 µm diam, gelatinized. PILEUS TRAMA: filamentous hyphae and inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: ramose to slightly inflated ramose, no clamps. BASIDIA: up to 51 x 4-10.5 µm, 4-sterigmate, no clamps. VOLVA: no volval remnants on pileus: volval material at base of stipe mostly filamentous hyphae, moderately branched, up to 8 µm diam, no clamps; inflated cells broadly elliptic, elliptic, clavate, cylindric, terminal, up to 94 x 40 µm. STIPE TRAMA: filamentous hyphae sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, cylindric, longitudinally oriented, up to 321 x 21 µm. PARTIAL VEIL: almost exclusively filamentous hyphae, moderately branched, up to 7 µm diam, no clamps; inflated cells few, clavate, terminal, up to 50 x 10 µm.

SPORES: 4.3-4.7 x 11.7-12.5(13.6) µm ($\underline{E}$ = 2.49-2.89; $\underline{E}^m$ = 2.63); cylindric, often adaxailly flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short cylindrical.

36. *Venenarius umbrinidiscus* Murrill. 1912. Mycologia 4(5): 242.
≡ *Amanita umbrinidisca* (Murr.) Murrill. 1912. Mycologia 4(5): 262.

Holotype: Seattle, Washington, 20. x. - 1. xi. 1911, W. A. Murrill 414(NY).

PILEUS: up to 50 mm broad, plano-convex to plane, margin striate, *melleous, fading to stramineous on the conspicuously long-striate margin, the umbo yellow in young plants, becoming umbrinous*; volval remnants as large membranous patch, frequently on disc. LAMELLAE: narrowly adnexed to just free, crowded, *white*. STIPE: up to 70 x 4-7 mm, tapering upward, apex slightly expanded, hollow, *white or slightly yellowish*, basal bulb only slightly swollen; annulus superior, only a few fragments remaining, *white*; volval remnants membranous, as a very shallow cup, *white*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. BASIDIA: up to 54 x 4-12 µm, 4-sterigmate, no clamps. SUBHYMENIUM: inflated ramose to subcellular, no clamps. VOLVA: filamentous hyphae at base of stipe dominant, moderately branched, up to 7 µm diam, no clamps; inflated cells conspicuous, terminal or short, terminal chains, broadly elliptic, up to 47 x 38 µm, with elongate to clavate, up to 78 x 15.5 µm: volval material on pileus with a much larger number of inflated cells, globose to broadly elliptic, up to 62 x 62 µm, with elongate, up to 70 x 15 µm; filamentous hyphae similar to that at base of stipe. STIPE TRAMA: filamentous hyphae sparsely branched, very inconspicuous, up to 6 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 327 x 46 μm. PARTIAL VEIL: primarily filamentous hyphae, moderately branched, densely interwoven, up to 7 μm diam, no clamps; inflated cells conspicuous, terminal, clavate, up to 94 x 22 μm.

SPORES: 7.0-7.8(8.6) x 10.2-11.7 μm ($\underline{E}$ = 1.31-1.56; $\underline{E}^m$ = 1.46), elliptic, often adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

37. *Venenarius vernellus* Murrill. 1944. Lloydia 7(4): 315-316.
≡ *Amanita vernella* (Murr.) Murrill. 1944. Lloydia 7(4): 327.

Holotype: Gainesville, Florida, 4. x. 1943, W. A. Murrill 20002(FLAS).

PILEUS: approximately 25 mm broad, plane, margin non-striate and incurved, *white, slightly stramineous at the center*; no volval remnants. LAMELLAE: free, crowded, *white*. STIPE: 55 x 2-3 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb subglobose; annulus superior, thin, membranous, few fragments remaining, *white*; volval remnants membranous, thin, lobed.

PILEIPELLIS: filamentous hyphae interwoven, 3-8 μm diam, gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: inflated ramose to subcellular, no clamps. BASIDIA: up to 35 x 4-8 μm, 1, but mostly 2-sterigmate, no clamps. VOLVA: no volval remnants on pileus: filamentous hyphae at base of stipe dominant, moderately branched, up to 7 μm diam, no clamps; inflated cells few, terminal, broadly elliptic, up to 125 x 94 μm. STIPE TRAMA: filamentous hyphae sparsely branched, very conspicuous, up to 7 μm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 218 x 21 μm. PARTIAL VEIL: almost exclusively filamentous hyphae, moderately branched, up to 7 μm diam, no clamps; inflated cells very few, terminal, small.

SPORES: 7.0-7.8(9.4) x 7.0-7.8(9.7) μm ($\underline{E}$ = 1.0-1.03; $\underline{E}^m$ = 1.001), globose, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

38. *Venenarius verniformis* Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 184-185.
≡ *Amanita verniformis* (Murr.) Murrill. 1945. Jour. Fla. Acad. Sci. 8(2): 198.

Holotype: Newnan's Lake, Alachua Co., Florida, 9. vii. 1944, W. A. Murrill 32931(FLAS).

PILEUS: approximately 57 mm broad, plano-convex, margin non-striate, slightly inrolled, *milk-white*; no volval remnants remaining. LAMELLAE: free, crowded, *white*. STIPE: 70 x 6-8 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb ovoid, *white*; annulus superior, membranous, fairly delicate, *white*; volval remnants membranous, lobed, relatively thick, 25 x 20 mm, *white*.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 μm diam, gelatinized. PILEUS TRAMA: undifferentiated, filamentous hyphae and inflated cells, elongate, with large number of subglobose to ovoid. LAMELLA TRAMA: bilateral. SUBHYMENIUM: unable to reinflate. BASIDIA: up to 51 x 4-14 μm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae at base of stipe moderately branched, dominant, up to 10 μm diam, no clamps; inflated cells few, terminal, clavate, up to

94 x 31 µm. STIPE TRAMA: filamentous hyphae abundant, sparsely branched, up to 8 µm diam, clamps occasional; inflated cells terminal, clavate, longitudinally oriented, up to 281 x 22 µm. PARTIAL VEIL: mostly filamentous hyphae, moderately branched, up to 10 µm diam, no clamps; inflated cells terminal, elliptic to fusiform, up to 45 x 20 µm.

SPORES: 7.0-7.8(8.6) x (9.4)10.2-10.9(11.7) µm ($\underline{E}$ = 1.12-1.56; $\underline{E}^m$ = 1.37), subglobose to elliptic, often adaxailly flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, short, truncate-conic.

39. *Venenarius virginianus* Murrill. 1914. North American Flora 10(1): 71.
≡ *Amanita virginiana* (Murr.) Murrill. 1914. Mycologia 6(5): 269.

Holotype: Mountain Lake, Virginia, 8-14. vii. 1909, W. A. Murrill 28(NY).

PILEUS: up to 15 mm broad, plane, margin strongly striate, *fuliginous, margin white*; no volval remnants remaining. LAMELLAE: free, crowded, *white*. STIPE: up to 38 x 1-2 mm, tapering upward, apex slightly expanded, stuffed to hollow, *white*, no basal bulb; no annular material remaining; volval remnants membranous, saccate, fairly sturdy, *white*.

PILEIPELLIS: filamentous hyphae interwoven, to subradial, 2-7 µm diam, gelatinized. PILEUS TRAMA: elongate, inflated cells and undifferentiated, filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose, no clamps. BASIDIA: up to 35 x 3-9 µm, mostly 1-2 sterigmate, rarely 4-sterigmate, no clamps. VOLVA: exclusively filamentous hyphae at base of stipe, interwoven, moderately branched, up to 8 µm diam, no clamps. STIPE TRAMA: filamentous hyphae dominant, up to 7 µm diam, sparsely branched, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 198 x 31 µm.

SPORES: 9.4-11.7(13.3) x 12.5-13.3(14.1) µm ($\underline{E}$ = 1.11-1.45; $\underline{E}^m$ = 1.28), subglobose to elliptic, often adaxailly flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

40. *Venenarius virosiformis* Murrill. 1941. Mycologia 33(4): 436.
≡ *Amanita virosiformis* (Murr.) Murrill. 1941. Mycologia 33(4): 448.

Holotype: Gainesville, Florida, 26. v. 1938, W. A. Murrill 16229 (FLAS).

PILEUS: approximately 50 mm broad, plano-convex, margin nonstriate, *white*; no volval remnants remaining. LAMELLAE: free, crowded, *white*. STIPE: 55 x 6 mm, tapering upward, apex slightly expanded, solid, *white*, basal bulb subglobose, 18 x 16 mm, *white*; volval remnants membranous, delicate, irregularly lobed, shallow, cup on apex of basal bulb.

PILEIPELLIS: filamentous hyphae interwoven, 3-8 µm diam, gelatinized. PILEUS TRAMA: filamentous hyphae and elongate, inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, no clamps. BASIDIA: up to 50 x 3.5-11.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae at base of stipe abundant, moderately branched, up to 7 µm diam, no clamps; inflated cells abundant, globose, subglobose, broadly elliptic, up to 63 x 63 µm, with fewer oblong elliptic to clavate, up to 63 x 21 µm, terminal or short, terminal chains. STIPE TRAMA: filamentous hyphae moderately abundant, sparsely branched, up to 8 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 118 x 21 µm. PARTIAL VEIL: almost exclusively filamentous hyphae, moderately branched, up to 8 µm diam, no clamps; inflated cells few, terminal, clavate to oblong elliptic, up to 31 x 11.5 µm.

SPORES: 3.9-4.7 x 11.7-13.3 µm ($\underline{E}$ = 2.49-3.41; $\underline{E}^m$ = 2.71), cylindrical to bacilliform, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, very short cylindrical.

41. *Venenarius watsonianus* Murrill. 1944. Lloydia 7(4): 316.
≡ *Amanita watsoniana* (Murr.) Murrill. 1944. Lloydia 7(4): 327.

Holotype: Camp O'leno, Columbia Co., Florida, 19. x. 1941, W. A. Murrill 21875(FLAS).

PILEUS: approximately 85 mm broad, plano-convex, margin nonstriate, incurved, glabrous, *white*; volval remnants as a few thin patches. LAMELLAE: widely free, crowded, *white*. STIPE: 95 x 12 mm, cylindrical, solid, *white*; volval remnants as a shallow cup, membranous, *white*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-7 µm diam, gelatinized. PILEUS TRAMA: inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, no clamps. BASIDIA: up to 43 x 4-11 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae dominant, sparsely to moderately branched, up to 6 µm diam, no clamps; inflated cells moderately conspicuous, broadly elliptic to elliptic, up to 47 x 31.5 µm, terminal or short, terminal chains: volval material at base of stipe similar to that on pileus. STIPE TRAMA: filamentous hyphae sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 343 x 25 µm.

SPORES: 3.9-4.7 x 11.3-14.1(15.6) µm ($\underline{E}$ = 2.90-4.00; $\underline{E}^m$ = 3.38), cylindrical to bacilliform, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, very short truncate.

Bas (1969) has placed this in synonymy with *Amanita roanokensis* Coker.

42. *Venenarius wellsii* Murrill. 1920. Mycologia 12(5): 291.
≡ *Amanita wellsii* (Murr.) Murrill. 1920. Mycologia 12(5): 292.

Holotype: Springfield, New Hampshire, 1. ix. 1917, W. A. Murrill s.n. (NY).

PILEUS: approximately 55 mm broad, convex to plano-convex, margin not striate, *salmon-colored, fading, especially after a rain, usually remaining more deeply colored on the disk*; volval remnants scarce, minimal amount of pulverulent material remaining, *yellowish-buff*. LAMELLAE: free, crowded, *pale dull yellow*. STIPE:

100 x 4-9 mm, tapering slightly upward, stuffed, *pale dull yellow*, basal bulb subglobose; annulus not present; volval remnants as sparsely scattered, pulverulent material, *distinctly yellow*.

PILEIPELLIS: filamentous hyphae interwoven to subradial, 3-8 µm diam, slightly gelatinized. PILEUS TRAMA: filamentous hyphae and elongate, inflated cells. LAMELLA TRAMA: bilateral. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, no clamps. BASIDIA: up to 47 x 4.5-9.5 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus moderately branched, up to 8 µm diam, rarely clamped; inflated cells in terminal chains, elliptic, clavate, fusiform, irregularly elongate, up to 110 x 25 µm, with fewer broadly elliptic to ovoid, up to 80 x 62 µm: volval remnants at base of stipe similar to that on pileus. STIPE TRAMA: filamentous hyphae moderately branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 470 x 38 µm.

SPORES: 6.3-7.9 x 11.0-12.6 µm ($\underline{E}$ = 1.48-2.00; $\underline{E}^m$ = 1.63), elliptic to cylindrical, adaxially flattened, hyaline, nonamyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

43. *Venenarius westii* Murrill. 1944. Proc. Fla. Acad. Sci. 7: 115.
≡ *Amanita westii* (Murr.) Murrill. 1944. Proc. Fla. Acad. Sci. 7: 127.

Holotype: Newnan's Lake, near Gainesville, Florida, 7. vii. 1938, Erdman West 17466(FLAS).

PILEUS: 70 mm broad, plano-convex, margin non-striate, slightly incurved, *pale reddish-brown*; volval remnants as irregularly shaped warts, mostly near center, few on margin. LAMELLAE: widely free, moderately crowded, *pale grayish-white, reddish-brown when dry*. STIPE: 45 x 8-11 mm, slightly expanded at apex, solid, basal bulb ovoid; annulus superior, very delicate, *pale reddish-brown*; volval remnants as a few warts on basal bulb.

PILEIPELLIS: filamentous hyphae interwoven, 3-7 µm diam, slightly gelatinized. PILEUS TRAMA: elongate, inflated cells and filamentous hyphae. LAMELLA TRAMA: bilateral. SUBHYMENIUM: inflated ramose, no clamps. BASIDIA: up to 63 x 4-15 µm, 4-sterigmate, no clamps. VOLVA: filamentous hyphae on pileus sparsely to moderately branched, up to 8 µm diam, no clamps; inflated cells subglobose, broadly elliptic to elliptic, up to 78.5 x 62.6 µm, terminal or short, terminal chains; volval remnants at base of stipe similar to that on pileus; filamentous hyphae same; inflated cells more numerous, usually larger, up to 109.5 x 94 µm, more elliptic and clavate, terminal or short, terminal chains. STIPE TRAMA: filamentous hyphae sparse, sparsely branched, up to 7 µm diam, no clamps; inflated cells terminal, clavate, longitudinally oriented, up to 174 x 41 µm. PARTIAL VEIL: filamentous hyphae moderately branched, up to 8 µm diam, no clamps; inflated cells numerous, terminal, elliptic, up to 69 x 31.5 µm.

SPORES: 7.0-8.6 x 12.5-13.3(14.1) µm ($\underline{E}$ = 1.45-2.00; $\underline{E}^m$ = 1.76), elongate, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate, apiculus sublateral, cylindrical.

44. *Leucomyces mexicanus* Murrill. 1911. Mycologia 3(1): 80.

Holotype: Motzorongo, Mexico, 15. i. 1910, W. A. Murrill 1067(NY).

PILEUS: up to 25 mm broad, plano-convex to plane, margin non-striate, inrolled, *milk-white*; volval material as a few membranous patches, randomly distributed. LAMELLAE: free to narrowly adnexed, crowded, *white*. STIPE: up to 45 x 1-3 mm, hollow, *white*, basal bulb ovoid, no annulus, volval remnants as floccose material at apex of basal bulb, *white*.

This specimen is not a member of the genus *Amanita*. This is evidenced by the lack of a bilateral gill trama and *Amanita*-type stipe trama, both of which are characteristic of *Amanita* (Hoffman, 1861: 11; Boudier, 1886: pl. 1, fig. 8; Bas, 1969: 328).

Singer (1944) has placed this specimen in the genus *Smithiomyces*.

ACKNOWLEDGEMENTS

I would like to thank Dr. Clark T. Rogerson, Senior Curator, New York Botanical Garden, and Dr. James W. Kimbrough, University of Florida, for providing type specimens.

LITERATURE CITED

Bas, C. 1969. Morphology and Subdivision of *Amanita* and a Monograph on its Section *Lepidella*. Persoonia 5(4): 285-579.

Hesler, L. R. 1975. William Alphonso Murrill. Biographical Sketches of Deceased North American Mycologists. Unpubl.

Jenkins, David T. 1977. A Taxonomic and Nomenclatural Study of the Genus *Amanita* Section *Amanita* for North America. Bibliotheca Mycologica 57: 1-126.

Lanjouw, J. 1966. International Code of Botanical Nomenclature. Utrecht.

Murrill, W. A. 1955. A New Species of *Amanita* from Florida. Mycologia 47(3): 427.

Singer, R. 1949. The Agaricales (Mushrooms) in Modern Taxonomy. Lilloa 22: 1-832.

Weber, George F. 1961. William Alphonso Murrill. Mycologia 53(6): 543-557.

MYCOTAXON

Vol. X, No. 1, pp. 201-209 October-December 1979

NOTES ON CORTICIACEAE (BASIDIOMYCETES) V.

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SUMMARY

Amyloathelia typified by Corticium amylaceum Bourd. & Galz. and A. crassiuscula nov. sp. are described. The genus is characterized by pellicular fruitbodies and thickwalled amyloid spores. Corticium laceratum Litsch. is transferred to Amylocorticium and the typification of Athelopsis lembospora is discussed. A preliminary key to the amyloid species in Corticiaceae of N. Europe is presented.

AMYLOATHELIA Hjortst. & Ryv. nov. gen.

Fructificatio resupinata, effusa, laxe adnata, pellicularis, paulatim membranacea, plus minusve rimosa; hymenio albido vel ochraceo; margine fibrilloso vel indeterminato. Systemate hyphali monomitico. Hyphis basalibus rectis, tenuitunicatis vel crassiusculis, interdum incrustatis; hyphis subhymenialibus irregularibus, sinuosis, omnisibus fibulatis. Cystidiis nullis. In hymenio hyphis paraphysoideis praesentes. Basidiis clavatis, generatim terminalibus, basaliter plus minusve elongatis, interdum lateralibus. Sporis crassitunicatis, levibus, amyloideis.

Generitype. Corticium amylaceum Bourd. & Galz.

Fruitbody resupinate, effuse, loosely adnate, at first byssoid to pellicular, in time thickened and distinctly membranaceous, usually cracking, in colour whitish to light ochraceous. Margin indeterminable or slightly fibrillose. Hyphal system monomitic. Basal hyphae thin to becoming thickwalled, straight and uniform, sometimes encrusted; subhymenial hyphae irregular, sinuous, all hyphae with clamps. Cystidia lacking but mostly with hyphal ends (paraphysoids) between the basidia. Basidia varying in shape, clavate, in some cases suburniform, terminal with more or less tapering base or sometimes lateral. Spores thickwalled, smooth, amyloid, in known species ellipsoid to subglobose.

Remarks. Among genera with amyloid spores Amyloathelia is easily recognized by its smooth and thickwalled spores and in lacking sterile elements such as gloeocystidia, dendrohyphidia, and acanthophyses. In outer appearance it is much like species of Athelia or other fungi in Corticiaceae with pellicular to membranaceous fruitbodies.

Amyloathelia amylacea is somewhat related to species of Melzericium in having similar basidia but is well separated by its thickwalled spores. As the thickness of the sporewall is a distinct characteristic and used for generic delimitiation e.g. in Hyphochicium, we consider this is a good reason to establish a new genus.

AMYLOATHELIA AMYLACEA (Bourd. & Galz.) Hjortst. & Ryv. nov. comb.

Basionym. Corticium amylaceum Bourd. & Galz. Bull. Soc. Myc. France, 27:259,1911.

Lectotype. France. Aveyron, Layrolle, sur genevrier. 1910-06-12. Galzin 6264, Bourdot 7408. GB.

Fruitbody resupinate, effuse, loosely adnate, at first more or less byssoid, later pellicular to soft membranaceous and often rimose, in colour generally white to creamish. Margin indeterminable. Hyphal system monomitic; basal hyphae thinwalled, somewhat encrusted straight and uniform, about 2-3 um in diam., subhymenial hyphae more irregular, all hyphae with clamps. Cystidia lacking but in most specimens paraphysoid hyphae between the basidia. Basidia polymorphous, sometimes distinctly clavate, in some cases suburniform, mostly terminal but some lateral basidia present, usually 20-35 x 6-7 um, with four sterigmata. Spores ellipsoid to subglobose, thickwalled, smooth, varying in size, generally 9-11 x 5-7 um, strongly amyloid.

Habitat. According to Lemke the species is growing on Thuja in North America. In Central Europe known as living on Juniperus.

Distribution in Europe. As far as we know only from Central Europe.

Remarks. Microscopically A. amylacea is readily recognized by its amyloid spores, and also in most cases, also by presence of paraphysoid hyphae in the basidial layer. Macros-

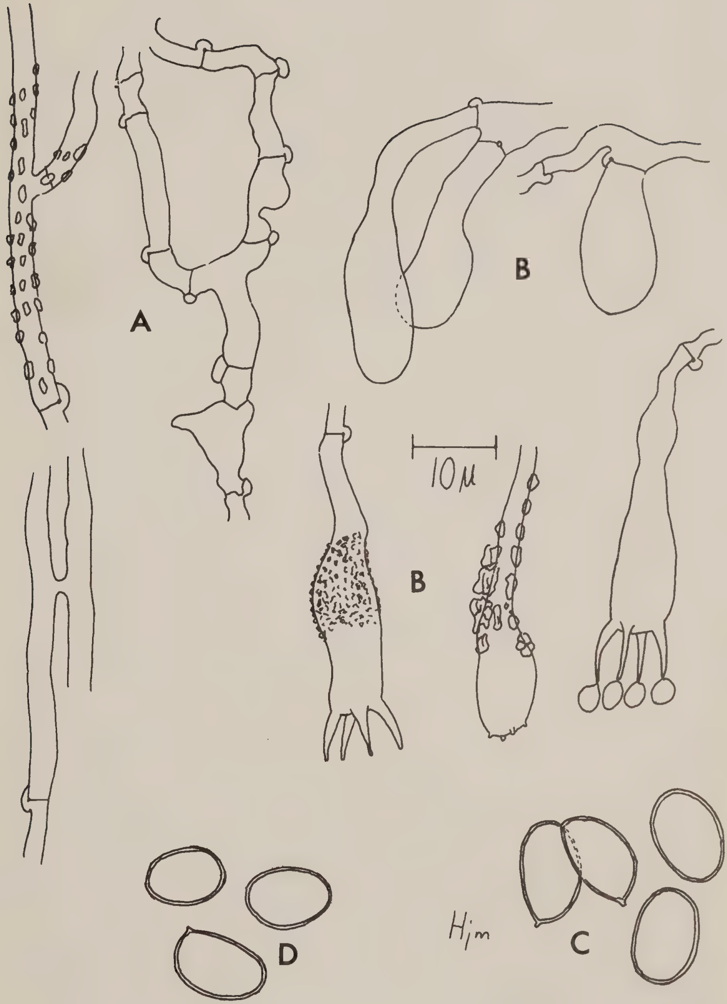
A
B
10μ
B
Hjm
C
D

Fig. 1. Amyloathelia amylacea a) hyphae b) basidia
c) spores - Coll. Hubert 1919-09-30 (U.S.A.)
d) spores - Coll. Bourdot 7408.

copically it is probably overlooked in bearing a close resemblance to species of Athelia or other pellicular taxa in Corticiaceae.

Lemke (1964) excluded C. amylaceum from Aleurodiscus as this genus is characterized by having sterile elements such as acanthophyses, dendrohyphidia or moniliform gloeocystidia between the basidia. Further, in many species there are ordinary gloeocystidia with a positive sulfovanilline reaction. Such sterile organs are absent from A. amylacea except for some partly projecting, simple hyphal ends, which here are called paraphysoid hyphae.

The spores of Amyloathelia are somewhat similar to those of Dendrothele. In the latter they are thickwalled and nonamyloid or with a weak and variable amyloid reaction. However, species of Dendrothele are confined to the bark of living trees and there are numerous dendrohyphidia in the hymenium. We are of the opinion that neither Aleurodiscus nor Dendrothele are appropriate genera for Corticium amylaceum.

Specimens studied.
West-Germany. Ober-Bayern, Kalvarienberg. 1912-08-31. H. Sydow (GB). France. Aveyron, Layrolle, sur genevrier. 1910-06-12. Galzin 6264 (Bourdot 7408) (GB). Canada. Ontario, Brant Co., Oakland Swamp, on Thuja occidentalis. 1939-10-09. leg. R. F. Cain. det. H. S. Jackson (GB): do. Etonia, on Thuja occidentalis. 1937-08-11. R. F. Cain (GB): York Co., E of Maple, on Thuja. 1935-11-02. H. S. Jackson (GB): S of Aurora, on Thuja occidentalis. 1942-09-27 H. S. Jackson (GB). Br. Columbia, Cowichan Lake For. Exp. St., on Thuja plicata. No date J. E. Bier. det. H. S. Jackson (GB). U.S.A. Idaho, Priest River, Barney Fox area, host unknown. 1919-07-30 Hubert det. John Eriksson (S).

AMYLOATHELIA CRASSIUSCULA Hjorst. & Ryv. nov. spec.

Fructificatio resupinata, effusa, adnata, pellicularis, crassiuscula, leviter rimosa; hymenio albido, posterior modice ochraceo; margine plus minusve indeterminato. Systemate hyphali monomitico; hyphis sparsim ramosis, hyalinis, 3-4 um latis, fibulatis. Cystidiis nullis. Basidiis clavatis, basaliter contractis, 20-30(-40) x 5-7 um, 4-sterigmatibus. Sporis ellipsoideis vel subglobosis, crassitunicatis, 5-7 x 4-4,5 um, amyloideis.

Holotype. Norway. Akershus, Nannestad, Horna river near Hurdal lake, 200-300 m.a.s.l., on deciduous wood. 1978-09-25. Hjortstam & Larsson Hjm 9941 (O).

Paratype. Norway. Akershus, Eidsvoll, Mistberget, northern slope near Tisjøen, 400 m.a.s.l., on Picea abies. 1978-09-26. Hjortstam & Larsson Hjm 10062 (O).

Fruitbody resupinate, effuse, loosely adnate, thin, pellicular and slightly cracking with age, whitish to light ochraceous, margin indistinct. Macroscopically similar to Athelia species. Hyphal system monomitic, hyphae with sparse

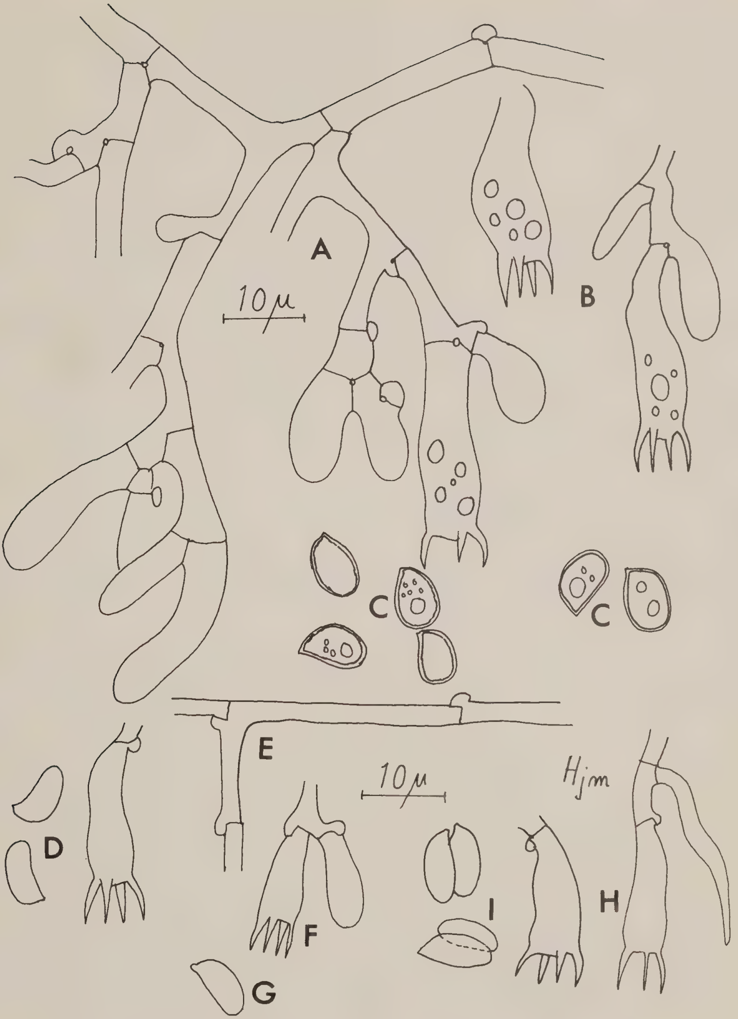

Fig. 2. Amyloathelia crassiuscula a) hyphae b) basidia c) spores - Coll. Hjortstam & Larsson 9941, type. Amylocorticium laceratum d) spores and basidium - Coll. Romell 3990, type. Athelopsis lembospora e) hyphae f) basidia g) spore - Coll. Hjortstam 7508 h) basidia i) spores - Coll. Eriksson 21791.

ramification, hyaline, about 3-4 um wide, with clamps at all septa. Cystidia lacking. Basidia clavate, basally slightly tapering 20-30(40) x 5-7 um, with four sterigmata. Spores ellipsoid to subglobose, smooth, thickwalled, slightly variable in size but generally 5-7 x 4-4,5 um, amyloid. Most of the spores have oil-droplets in the protoplasm.

Distribution. Only known from the type and paratype localities.

The species is easily recognized by its thickwalled and amyloid spores. It is closely related to A. amylacea but well separated by smaller spores and shorter and less elongated basidia. Paraphysoid hyphae have not been observed as in A. amylacea.

AMYLOCORTICIUM LACERATUM (Litsch.) Hjortst. & Ryv. comb. nov.

Basionym. Corticium laceratum Litsch., Ann. Mycol. 39: 118-119, 1941.

Holotype. Sweden. Stockholm, Bromma, on decayed conifer wood. 1918-04-21 Lars Romell 3990 (S). Isotype in GB.

This species has been described and illustrated by Eriksson and Ryvarden (1973) and placed in Athelopsis. At that time only the type was available and the amyloid reaction of the spores escaped their attention.

Recently, Hjortstam (1978) reported A. laceratum from Västergötland in Sweden. However, these collections are not Amylocorticium laceratum but Corticium lembosporum Bourd.

Microscopically these two species are very similar but well separated in the amyloidity of the spores. The sporewall is very thin in A. laceratum but the amyloidity is rather easily observed, especially in collapsed spores, which usually occur in the subhymenial layer. Besides, the hyphae are more narrow and the basidia as well as the spores are usually smaller. The description and figure in Eriksson and Ryvarden are in accordance with the material studied by us, except for the information of non-amyloid spores.

Habitat. On dead coniferous branches, preferably on Pinus.

Distribution. Specimens have been examined from Västergötland and Uppland in Sweden, Hedmark, Nordland and Troms in Norway and Huesca prov. in Spain.

ATHELOPSIS LEMBOSPORA (Bourd.) Oberw., Persoonia 7 (1):3, 1972.

CORTICIUM LEMBOSPORUM Bourd., Rev. sci. Bourd. 23:10, 1910.

Specimens examined (all from PC).
Lectotype. France. Aveyron, St. Sernin. 1909-05-11 Galzin 4292, Bourdot 6517. France. Aveyron, Vergnas. 1910-10-09 Galzin 7116, Bourdot 7625.

Liberta (1961) selected the Bourdot collection 6517 as lectotype. However, today this collection is completely destroyed and no information can be obtained from it. Thus, we propose to reject this typification and instead select Bourdot 7055. On the label of this collection there are good annotations and fine figures of hyphae with clamps, basidia and spores made by Bourdot himself. The collection is in good condition and there is no doubt that it covers his concept of the species. Liberta (1961) selected Bourdot 7625 as the type of Corticium confusum Bourd. & Galz. This collection is the same as Bourdot 7055, and thus, Corticium confusum Bourd. & Galz becomes a synonym of Corticium lembosporum Bourd.

Description of A. lembospora.
Fruitbody resupinate, effuse, loosely adnate, smooth, pellicular, whitish, margin not especially differentiated. Hyphal system monomitic, basal hyphae straight and uniform, thinwalled, 2-2,5 um wide, subhymenial hyphae more ramified and slightly broader, all hyphae with clamps. Cystidia lacking but in some collections with paraphysoid hyphae between the basidia. Basidia clavate, tapering towards the base, 15-25 x 5-7 um, with four sterigmata. Spores short-allantoid, broadened towards the base, thinwalled, generally 7-8 x 3 um, often glued together in pairs.

Habitat. Collected on Athyrium filix-femina and Dryopteris, in favourable localities as well as on Equisetum pratense. Also some collections on deciduous wood. Not known on conifer.

Distribution. Probably a rare species and previously not reported from North Europe. In Norway only known from Oslo and in Sweden from Bohuslän, Halland, and Västergötland.

Remarks. Athelopsis lembospora has been discussed by Liberta (1961) and by Oberwinkler (1965). Jülich (1975) transferred the species to Luellia but the type of this genus is brown because of coloured hyphae, and also because of other characteristica we are of the opinion that C. lembospora is unacceptable in this genus. See also Eriksson and Ryvarden (1967).

In basidial morphology this species is closely related to other species of Athelopsis, especially the type species A. glaucina. The basidia have more or less stalked bases, the hyphae are thinwalled, and the spores are neither amyloid nor cyanophilous. Moreover, the fruitbody is distinctly athelioid (pellicular).

PRELIMINARY KEY TO
THE CORTICIACEAE OF NORTH EUROPE

Part 1. Species with amyloid spores

1. Spores echinulate - verruculose 2
1. Spores smooth 9

2. Dimitic or trimitic species 3
2. Monomitic species 4

3. Trimitic, fruitbody often more or less pileate, with numerous metuloids, gloeocystidia absent .... Laurilia
3. Dimitic, fruitbody resupinate, encrusted cystidia present or lacking, gloeocystidia present. If skeletal hyphae dextrinoid, see Scytinostroma .... Scytinostromella

4. Hyphae without clamps 5
4. Hyphae with clamps 6

5. Spores large 10-25 um long .... Aleurodiscus
5. Spores smaller, usually 5-8 um long . Gloeocystidiellum

6. Basidia lateral .... Pseudoxenasma
6. Basidia terminal, some lateral may occur 7

7. Spores large 10-20 um long .... Aleurodiscus
7. Spores smaller 8

8. Gloeocystidia with sulfovanilline reaction .... Gloeocystidiellum
8. Gloeocystidia without such reaction .... Laxitextum

9. Fruitbody pileate, hymenium hydnoid or sublamellate .... Irpicodon
9. Fruitbody in most cases resupinate, hymenium smooth 10

10. Hyphal system dimitic, fruitbody steroid or/and strongly cracked 11
10. Hyphal system monomitic, in most cases corticioid 13

11. Metuloid cystidia present .... Amylostereum
11. Metuloid cystidia absent 12

12. Acanthophyses numerous .... Xylobolus
12. Acanthophyses absent or rarely seen .... Stereum

13. Clamps absent 14
13. Clamps present 17

14. Sterile elements in the basidial layer present 15
14. Sterile elements absent 16

15. Vesicular gloeocystidia present, dendrohyphidia absent .... Vesiculomyces
15. Dendrohyphidia present together with gloeocystidia .... Dendrothele

16. Fruitbody violaceous, spores ellipsoid - subfusiform, basal hyphae 7-12 um wide .... *Hypochnella*
16. Fruitbody whitish - reddish, spores allantoid, basal hyphae 3-5 um wide .... *Amylocorticium*

17. Metuloids present .... *Amylostereum*
17. Metuloids absent, but other cystidial organ sometimes present 18

18. Spores thickwalled 19
18. Spores thinwalled 21

19. Cystidia present .... "*Leucogyrophana" mollis*
19. Cystidia absent 20

20. Spores relatively large, 5-12 um long and distinctly amyloid .... *Amyloathelia*
20. Spores smaller, 3-5 um long, indistinctly amyloid, mostly greyish in Melzer ...."*Leucogyrophana" subillaqueta*

21. Cystidia present .... *Amylocorticium*
21. Cystidia absent 22

22. Fruitbody closely adnate, hyphae gelatinized, indistinct ....*Xenasmatella*
22. Fruitbody pellicular - membranaceous 23

23. Basidia in some cases lateral, spores ellipsoid - reniform .... *Melzericium*
23. Basidia strictly terminal, spores allantoid .... *Amylocorticium*

References

Eriksson, J. & Ryvarden, L. 1973-76: The Corticiaceae of North Europe 2-4. Oslo.

Hjortstam, K. 1978: Vedbeboende svampar från Råbäck på Kinnekulle. Svensk Bot. Tidskr. 72: 321-326.

Hjortstam, K. & Larsson, K. H. 1974: Luellia, a new genus in the Corticiaceae. Svensk Bot. Tidskr. 68: 57-63.

Jülich, W. 1975: Studies in resupinate Basidiomycetes - III. Persoonia 8: 291-305.

Lemke, P. A. 1964: The genus Aleurodiscus (sensu stricto) in North America. Can. Journ. Bot. Vol. 42: 214-282.

Liberta, A. E. 1961: A taxonomic analysis of section Athele of the genus Corticium. II. Mycologia 53: 443-450.

Oberwinkler, F. 1965: Primitive Basidiomyceten. Sydowia 19: 1-72.

MYCOTAXON

Vol. X, No. 1, pp. 210-212 October-December 1979

STUDIES IN THE LICHEN FAMILY PHYSCIACEAE. V. TWO SPECIES OF *PHYSCIA* NEW TO NORTH AMERICA

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SUMMARY

Physcia dimidiata *(Arn.) Nyl. and* Ph. magnussonii *Frey are reported as new to the North American lichen flora.* Physcia dimidiata, *a sorediate species known previously from Europe, has been found in North Dakota. The fertile species* Ph. magnussonii, *also previously known only from Europe, is now known from Washington and Idaho.*

General collecting of lichens has turned up two previously unreported species of *Physcia* for North America. The following descriptions are based only on the North American specimens examined.

PHYSCIA DIMIDIATA (Arn.) Nyl.

Thallus up to 4 cm in diameter, the upper surface white to gray or blue-gray, sometimes with a slight brownish tinge in part, pruinose more or less throughout and often heavily so. Lobes more or less flat, 1-3 mm broad, the tips crenate. Sorediate, the soralia mostly marginal and elongate, occasionally very weakly labriform, laminal soralia also sometimes developing in older portions; soredia granular, pale gray or darkening. Lower surface white to tan or slightly brownish, the rhizines mostly concolorous with the lower surface. Upper cortex paraplectenchymatous, lower cortex prosoplectenchymatous.

Apothecia sessile, infrequent, up to 1 mm in diameter, the disk black but lightly pruinose, the margin weakly crenate and becoming eroded and sorediate; ascospores 18-20 x 6-7 µm, of the *Physcia*-type.

Chemistry: Atranorin only (by TLC); cortex K+ yellow, medulla PD-, K-, C-, KC-.

The previously known distribution of this species was mapped by Moberg (1971) who reported it from Norway and central Europe. Although I have it only from western North Dakota, it seems probable that *Ph. dimidiata* will be found more broadly distributed as the western North American lichen flora becomes better known.

The linear marginal soralia and the pruinose upper surface which reacts K+ yellow are diagnostic for this species and there are few others likely to be confused with it. Moberg (1971) compared it with *Ph. dubia* (Hoffm.) Lynge and *Ph. tribacia* (Ach.) Nyl., both of which have primarily labriform or laminal soralia and little or no pruina. In North America, the southern species *Ph. crispa* Nyl. (=*Ph. albicans* (Pers.) Thoms.) has similar marginal soralia but is usually pruinose only on the young lobe margins and has a K+ yellow medulla. At first glance, because of the pruinosity, *Ph. dimidiata* bears a superficial similarity to a *Physconia* species, but the upper cortex in members of that genus is K-. It seems probable that the report by Wetmore (1967) of a K+ yellow form of *Physconia grisea* (Lam.) Poelt (as *Physcia grisea*) from the Black Hills, an area with strong floristic similarities to western North Dakota, is actually based on *Physcia dimidiata*.

Specimens examined: North Dakota. Billings Co.: in the South Unit of the Theodore Roosevelt National Memorial Park, vicinity of the Ridgeline Nature Trail, on bark at the base of Juniper, *Esslinger 6858* (NDA), on bark of dead Juniper, *Esslinger 6867* (NDA). Slope Co.: about 7 miles N and 9 miles W of Amidon, near Logging Camp Ranch in the Ponderosa Pine area, over mosses on a large boulder, *Esslinger 6746* (NDA).

PHYSCIA MAGNUSSONII Frey

Thallus up to 6 cm in diameter, the upper surface gray, often with a brownish tinge, especially on the lobe-ends, pruinose more or less throughout but more strongly so near the lobe-ends. Lobes more or less flat, 0.8-3 mm broad, the tips crenate. Without soredia or isidia. Lower surface tan to yellowish or pale brownish, with similarly colored rhizines, the rhizines simple but often tufted at the end. Upper cortex paraplectenchymatous, lower cortex prosoplectenchymatous.

Apothecia short stipitate, up to 3 mm in diameter, the disk black but lightly pruinose, the margin entire or becoming grossly crenate; ascospores 14-21 x 6.5-9 µm, of the pachysporaria-type but rather irregular, faintly but definitely ornamented when mature.

Chemistry: Atranorin only (by TLC); cortex K+ yellow, medulla PD-, K+ yellow (in white areas) or K+ dingy-rose (in discolored areas), C-.

Physcia magnussonii was known previously only from Scandinavia (Moberg, 1977) and central Europe (Frey, 1963; Poelt, 1969). In North America, it apparently has a western or northwestern distribution. In addition to the below cited collections from Washington and Idaho, this species has been reported from Oregon by Dr. Amy Y. Rossman (in litt.).

The pruinose thallus, K+ yellow to dingy rose medulla, and the saxicolous habit will distinguish this *Physcia* from other North American species. The faintly ornamented spores, although somewhat difficult to distinguish, are also diagnostic.

Specimens examined: Idaho. Bonner Co.: Priest River Experimental Forest, on large exposed boulder, *Esslinger 585* (Herb. Esslinger). Washington. Spokane Co.: Turnbull National Wildlife Refuge, on soil over rock, *Esslinger 2476* (Herb. Esslinger); near N end of Fish Lake, on rock, *Esslinger 189* (Herb. Esslinger).

Literature Cited

Frey, E. 1963. Beiträge ze einer Lichenenflora der Schweiz II. III. Die Famile Physciaceae. Ber. Schweiz. Bot. Ges. 73: 389-503.

Moberg, R. 1971. *Physcia dimidiata* new to Scandinavia Svensk Bot. Tidskr. 65: 133-137.

Moberg, R. 1977. The lichen genus *Physcia* and allied genera in Fennoscandia. Symb. Bot. Upsal. 22: 1-108.

Poelt, J. 1969. Bestimmungsschlüssel Europaischer Flechten: 1-757. J. Cramer, Lehre.

Wetmore, C. 1967. Lichens of the Black Hills of South Dakota and Wyoming. Publ. of the Mus., Michigan State Univ. 3: 209-464.

MYCOTAXON

Vol. X, No. 1, pp. 213-216 October-December 1979

ADDITIONS TO THE DIAPORTHALES

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1. Orthography

Dr. R. A. Shoemaker has pointed out that genera such as *Plagiostoma*, although originally and in Barr (1978) treated as feminine are neuter (Stearn, 1966) and that species epithets should be corrected to read: *Plagiostoma acerophilum* (Dearn. & House) Barr, *P. alneum* (Fries) von Arx and *P. alneum* var. *betulinum* Barr, *P. bavaricum* (Rehm) Barr, *P. campylostylum* (Auersw.) Barr and *P. campylostylum* var. *mirabile* (Peck) Barr, *P. devexum* (Desm.) Fckl., *P. euphorbiis* (Fckl.) Fckl., *P. inclinatum* (Desm.) Barr, *P. magnoliis* (Ell.) Barr, *P. micromegalum* (Ell. & Ev.) Barr; also *Apioplagiostoma aceriferum* (Cke.) Barr, *A. carpinicolum* (von Höhnel) Barr, *Pleuroceras groenlandicum* (Rostr.) Barr, *P. helveticum* (Rehm) Barr, *P. pleurostylum* (Auersw.) Barr, *P. tenellum* (Ell. & Ev.) Barr.

2. Hapalocystis

A recent collection from Georgia provided a specimen of *Melanconis corni* Wehm., a species that Wehmeyer (1941) arranged in section Thelebolae of *Melanconis*, and that Barr (1978) suggested might belong in *Melanconis* ss. str. This specimen (on *Cornus florida* L., University of Georgia Botanical Garden, Athens, Clarke Co., Georgia, 25 Aug 1978, Barr 6476, MASS) agrees with Wehmeyer's description of the species from Georgia. The oblique, circinately grouped perithecia are surrounded by a thin pseudoparenchymatous stromatic layer; the lateral beaks are fused together as an enlarged structure containing a single canal. The combination of characters makes it necessary to refer the species to subfamily Massariovalsoideae, tribe Massariovalseae in the Melanconidaceae. In this tribe, I had separated

Massariovalsa from *Hapalocystis* (Barr, 1978) on the bases of ascospore septation and presence or absence of a gel coating and appendages, but the conidial states are also quite different for species of the two genera. The genera of tribe Massariovalseae may be separated more precisely:

1. Ascospores dark brown, one septate, not appendaged, surrounded by wide gel coating; conidial state *Melanconiopsis*, conidia dark brown, one celled, obovoid or subgloboid, surrounded by gel coating....... *Massariovalsa*
1. Ascospores hyaline or light brown or dark brown in age, one or several septate, terminal appendages broad, pulvinate or straplike, usually surrounded by narrow inconspicuous gel coating; conidial state *Stilbospora*-like, conidia hyaline or brown, ellipsoid or cylindroid, several septate, without gel coating...... *Hapalocystis*

Melanconis corni does present some problems: the ascospores are one septate as in *Massariovalsa* but are light vinaceous brown, surrounded by a narrow indistinct gel coating and bear short pulvinate appendages. The conidial state (Wehmeyer, 1940) is similar to those known for species of *Hapalocystis*, e.g., *H. ulmi* (Wehm.) Barr, where conidia and ascospores remain hyaline until shortly before germination. On balance, *M. corni* is more allied to species of *Hapalocystis*, as Wehmeyer noted in his discussion (1940, as *Prosthecium* subgenus *Pseudoprosthecium*), than elsewhere. The transfer of this species is proposed as
Hapalocystis corni (Wehm.) Barr, comb. nov.
Basionym: *Melanconis corni* Wehm. Mycologia 32: 324. 1940
Synonym: *Melanconiella corni* (Wehm.) Petrak, Sydowia 6: 15. 1952.

Hapalocystis corni is a small species of the genus; the ascospores measure 16-25 x 7-9 µm and the terminal appendages are pulvinate, 3-5 µm wide and 2-3 µm long. The configuration of perithecia and adherent stromatic tissues, covered by a film of brown hyphae, is in accord with other species of *Hapalocystis*.

3. Dicarpella

An inquiry about relationships of *Cryptosporella* with *Physalospora*, based on similarities in presumptive conidial states between species of *Cryptosporella* and *Physalospora quercifolia* Ell. & Ev., prompted re-examination of the latter. Earlier (Barr, 1964) I had excluded that species from *Pseudomassaria*, where von Arx (1952) had placed it, and left it in *Physalospora*. The intimately associated and presumed conidial state, *Mastigosporella hyalina* (Ell. & Ev.) von Höhnel, appears to be related to species of *Harknessia* Cooke, whose presumed perfect states are species of *Cryptosporella*. On the other hand, this sort of conidial state is not of the type known to occur in the Physosporellaceae where Barr (1976) now arranges *Physalospora*.

The short-beaked perithecia of *P. quercifolia* (on *Quercus coccinea* Muenchh., Newfield, New Jersey, 6 Jun 1885, Ellis & Everhart N.A.F. 1666, MASS) are surrounded by a narrow pseudoparenchymatous stromatic layer. In 3% KOH the stromatic layers of cells become light vinaceous while the compressed cell layers forming the peridium darken to a dull brown, especially in the upper region. The ellipsoid asci have a shallow refractive apical annulus that is nonamyloid and, in the aged herbarium material available, showed no definite chitinoid reaction. No paraphyses were seen, a negative feature because they are often compressed or deliquescent in mature specimens of species of the Physosporellaceae. The entire aspect of this fungus is similar to that of *Dicarpella georgiana* (Miller & Thompson) Barr, on leaves of species of *Nyssa* and *Liquidambar*. A conidial fungus is connected with *D. georgiana* by association and by similarities in pigmentation in KOH and ascospore-conidium shapes -- tentatively termed a foliicolous variant of *Harknessia americana* (Mont.) Sutton by Barr (1978) but better considered a species of *Mastigosporella* because of the hyaline to yellowish conidia that bear an apical appendage. The following combination is proposed:

Dicarpella quercifolia (Ell. & Ev.) Barr, comb. nov.
Basionym: *Physalospora quercifolia* Ell. & Ev. J. Mycol. 1: 92. 1885.
Synonyms: *Laestadia quercifolia* (Ell. & Ev.) Cooke, Grevillea 18: 65. 1890.
Pseudomassaria quercifolia (Ell. & Ev.) von Arx Ber. Schweiz. Bot. Ges. 62: 353. 1952.

The ascospores and conidia of *D. quercifolia* are narrower and longer, thus more fusoid (ascospores 15.5-25 x 4.5-7.5 µm, conidia 22.5-24 x 4.5-5 µm) compared to those of *D. georgiana* (ascospores 13-18(-23) x 6-8(-9) µm, conidia 13-22(-26) x 6-8 µm). The ascospores of *D. bina* (Harkn.) Sydow & Sydow, the type species, are broader, 7.5-12 µm, and the asci are two spored. This species develops in spotted areas of living leaves of *Quercus agrifolia* Neé, and no conidial association has been observed.

LITERATURE CITED

Arx, J. A. von. 1952. Über einige Ascomycetengattungen mit ungleich zweizelligen Sporen. Ber. Schweitz. Bot. Ges. 62: 340-362.

Barr, M. E. 1964. The genus *Pseudomassaria* in North America. Mycologia 56: 841-862.

__________. 1976. *Buergenerula* and the Physosporellaceae. Mycologia 68: 611-621.

__________. 1978. The Diaporthales in North America with emphasis on *Gnomonia* and its segregates. Mycol. Mem. 7: 1-232.

Stearn, W. T. 1966. Botanical Latin. Hafner Publ. Co., New York. 566 p.

Wehmeyer, L. E. 1940. Cultural histories of *Melanconis* and *Pseudovalsa*. IV. Mycologia 32: 321-330.

__________. 1941. A revision of *Melanconis*, *Pseudovalsa*, *Prosthecium*, and *Titania*. Univ. Michigan Stud. Sci. Ser. 14: 1-161.

MYCOTAXON

Vol. X, No. 1, pp. 217-218 October-December 1979

KUTILAKESA PIRONII SP. NOV., A STEM GALL- AND CANKER-INCITING FUNGUS, NEW TO THE UNITED STATES

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Nectriella pironii Alfieri and Samuels (2) causes stem galls and cankers on *Aphelandra squarrosa* Nees, *Clerodendrum bungei* Steud., and *Codiaeum variegatum* Blume (1). In addition to the perfect state, this fungus has an anamorph referred to the genus *Kutilakesa*. It appears to be an undescribed species differing from the previously reported species, *Kutilakesa madreeya* (4,5) and *Kutilakesa circinosetifera* (3). *Kutilakesa* is the predominant stage found in nature and is demonstrated to cause stem galls and cankers on the various hosts (1). Although the perfect state has been formerly described (2), I feel that it is practical and appropriate to establish a binomial for this imperfect state.

Kutilakesa pironii sp. nov.

Sporodochia alba, erumpentia, sessilia, 250-750 µm maxima dimensione. Phialides 7-12 x 1.5-2.5 µm. Conidia pallide aurantiaca, unicellularia, ellipsoidea, 6-8 (-9) x 2.0-2.5 µm. Pili e sporodochiis nascentes, septati, undulati, spinulosi, 50-150 x 4-5 µm, primo albi, deinde flavidi.

Holotypus: USA: Gainesville, in artificialibus inoculationibus truncorum *Aphelandra squarrosa* Nees, S. A. Alfieri, Jr. Mar 1978 (G.J. Samuels 78-24), NY.

Sporodochia white, erumpent, 250-750 µm maximum dimension. Phialides 7-12 x 1.5-2.5 µm. Conidia pale orange, unicellular, ellipsoidal, 6-8 (-9) x 2.0-2.5 µm. Hairs arising from sporodochium are septate, undulate, spinulose, 50-150 x 4-5 µm, at first white, then pale yellow.

Holotype: USA: Gainesville, on artificially inoculated stem of *Aphelandra squarrosa* Nees, S. A. Alfieri, Jr. March 1978 (G. J. Samuels 78-24), NY.

Literature Cited

1. Alfieri, S. A., Jr., J. F. Knauss, and C. Wehlburg. 1979. A stem gall- and canker-inciting fungus, new to the United States. Plant Dis.Reptr. 63: (in press).
2. Alfieri, S. A., Jr., and G. J. Samuels. 1979. Nectriella pironii sp. nov. and its Kutilakesa-like anamorph, a parasite of ornamental shrubs. Mycologia 71: (in press).
3. Matsushima, T. 1971. Microfungi of the Solomon Islands and Papua-New Guinea. Published by the author. Kobe, Japan. 78 p.
4. Subramanian, C. V. 1956. Hyphomycetes II. J. Ind. Bot. Soc. 35:446-494.
5. Subramanian, C. V. Hyphomycetes, an account of Indian species except Cercosporae. Indian Council of Agricultural Research. New Dehli. 930 p.

MYCOTAXON

Vol. X, No. 1, pp. 219-232 October-December 1979

ZOOPHTHORA ERINACEA SP.N. (ZYGOMYCETES : ENTOMOPHTHORACEAE), A FUNGAL PARASITE OF APHIDS

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SUMMARY

Zoophthora erinacea sp.nov. attacked *Aphis craccivora* throughout the year and *A. umbrella*, *A. fabae* and *Myzus persicae* in winter in a number of localities in the Coastal Plain of Israel and in the Jordan Valley. The fungus proved infective to *Aphis spiraecola*. It possessed mononucleate, turbinate conidia with an outer wall which sometimes separated, digitate conidiophores and many unusually long and thick cystidia, giving the dead hosts a hedgehog appearance. Cystidia were occasionally bifurcate. The primary conidia produced, on short conidiophores, secondary conidia resembling primary ones, but smaller. Resting spores were regularly echinulate, subhyaline zygospores, produced by conjugating hyphal bodies. True rhizoids were absent and diseased aphids clung to the plants by their rostra. The taxonomic position of this fungus, in relation to Batko's classification of entomophthoraceous fungi is discussed, as are some of the genera and subgenera employed by Batko.

INTRODUCTION

In May 1977, a number of dead specimens were noticed in small populations of the cowpea aphid, *Aphis craccivora* Koch (Homoptera : Aphididae), in an alfalfa field near Rehovot, in the Coastal Plain of Israel. Microscopic examination revealed an entomophthorosis, with the conidial stage present. The fungus resembled *Zoophthora montana* (Thaxter) Batko (=*Entomophthora montana* (Thaxter)Gustafsson)

(Thaxter, 1888; Gustafsson, 1965; Batko, 1964 d), known only from Dipteran hosts and never encountered in Israel. The same field was inspected again in August 1978 and the same disease was again found on many individuals of this host; others showed the conidial stage of *Triplosporium fresenii* (Nowakowski) Batko (=*Entomophthora fresenii*(Nowak.) Gustafsson)(Batko, 1964 b; Gustafsson, 1965).

During December 1977, January and February 1978, the new disease caused different degrees of mortality in both homogeneous and heterogeneous populations of the mallow aphid, *Aphis umbrella* Börner, and the green peach aphid, *Myzus persicae* Sulzer on *Malva* sp. in and near citrus groves at Be'er-Ya'akov and Mikveh-Israel in the Coastal Plain. Heavy mortality occurred also in a dense, homogeneous population of *A. umbrella* on *Malva* sp. at Sdeh-Eliyahu in the Beith-Shean Valley (which is part of the Jordan Valley). Some of these populations were stricken also by *Zoophthora aphidis*, *Triplosporium fresenii* and *Entomophthora planchoniana* Cornu.

During January 1979 the aforementioned alfalfa field was inspected, together with the different weeds growing on its borders and between the alfalfa plants. At the beginning of the month only the new disease was found on *A. craccivora* on alfalfa and on *A. umbrella* on *Malva* sp.. Some of the dead aphids of both species were filled with resting spores which were later identified as belonging to the fungus causing the new disease. Later in the month, both conidial and resting spore stages of that fungus were formed also in different individuals of *Aphis fabae* Scopoli on *Ammi majus* (in the same field), together with *T. fresenii*. *Z. aphidis* was present then on all the three species of aphids.

DESCRIPTION OF DISEASE AND PATHOGEN

In spite of the color differences in the four aforementioned aphid species, all the dead aphids from which conidia were discharged took on a rusty-brown color.

The development of the fungus was followed in artificially inoculated *Aphis spiraecola* Patch (Bitton, 1978), as well as in naturally infected aphid species.

Measurements of spores and other structures were made from slide preparations in lactophenol-aniline-blue which had been gently heated.

Living infected aphids and recently dead ones were filled with different amounts of branched mycelium and mycelial segments (hyphal bodies) of different lengths and shapes (Fig. 6). Shorter and wider, often ramified, hyphal bodies were present in individuals in which resting spore formation was observed (Fig. 7).

The first structures which protruded from recently dead hosts were the very thick cystidia: (15.8) 22.1-28.0 (39.5) µm, (24.3± 5.4 µm, x̄±s, 36 measurements), occasionally branched in the form of the letter Y (Fig. 3). The emergence of before conidiophores had been observed also in *Zoophthora aphidis* (=*E. aphidis*) (Brobyn and Wilding, 1977). They usually extended outside the host's integument 150-225 µm, but some were approximately twice as long and these seemed to be adhesive over their entire length, as they stuck to the glass slide on which the dead aphid had been placed. Rhizoid-like endings were not formed on cystidia, however, and a thorough search for rhizoids (with specialized endings) never revealed any.

Keeping in mind Brobyn and Wilding's (1977) findings, fine rhizoids were looked for around the mouth parts of dead aphids, but were never found.

Clusters of branched, septate conidiophores surrounded each long cystidium. These clusters, when viewed from the side, were almost spherical in shape, with a central projecting cystidium. After a few hours, with more conidiophores elongating, the whole mass coalesced over the entire integument at one level, with only the cystidia protruding (Fig. 1). That part of the cystidium which was outside the host was coenocytic and partially or completely filled with cytoplasm, while the intra-host part was septate in short, empty compartments (Fig. 6). In moist chambers, primary conidia were ejected to a distance of up to 5 mm. They were hyaline, usually with one or two large vacuoles, sometimes with several smaller ones. The single nucleus present in each conidium was located at one side of the vacuole, or among them when several small vacuoles were present, its shape varying according to its position, which was seemingly dictated by the form and number of vacuoles. In germ-tubes formed by germinating conidia the nucleus always assumed a sausage-like shape.

The conidia were of the *Turbinata*-type (according to Lakon, 1919), long, turbinate (obconical). They tapered evenly to a narrow papillate base, the papilla being short, rounded and surrounded by a barely visible collar. They were symmetrical or slightly curved toward the base; (12.6) 15.0-18.2 (20.5) x (7.1) 7.9-11.0 (13.4)µm, (16.5±1.3 x 9.3 ±1.1 µm, length x̄±s x width x̄±s, 100 measurements), with length/width ratio of 1.4-2.2 (1.8±0.1, x̄±s, 100 measurements).

The primary conidia were measured at random from a microscopic preparation made from conidia ejected onto a glass slide for only a short period in order not to allow them time to produce secondary conidia; thus there were very few resporulating conidia in this preparation. The measured dimensions formed a very symmetrical bell-shaped distribution curve with 72% of the lengths and 70% of the widths in the $\bar{x}\pm1s$ range; 95% of the lengths and 98% of the widths were in the $\bar{x}\pm2s$ range, only 1% of the lengths were greater than $\bar{x}+2s$ and 4% smaller than $\bar{x}-2s$. This very last fact strongly suggests that part of those conidia which were 13.9 µm long, or shorter, were secondary conidia.

The diameter of the internal hyphal (bodies) segments, in aphids showing the conidial stage, was like that of the conidiophores : 4.7-7.2 µm (5.6±0.5 µm, $\bar{x}\pm s$, 50 measurements).

The primary conidia germinated on wetted glass slides and on rich agar media by means of germ-tubes growing from the apex or through the papilla and sometimes from both, or by means of a short, usually laterally-borne conidiophore, on which a secondary conidium, smaller than the primary but similarly shaped, was formed and then forcibly ejected (Figs. 2 and 5). Germination of primary conidia through the papilla had been observed in *Entomophthora turbinata*

FIGURES 1-6 *Zoophthora erinacea* sp.n. conidial stage

1. Dead aphid covered by conidiophores, the protruding cystidia giving it a "hedgehog appearance". X 40.

2. Primary and secondary conidia; secondary conidium formation at lower right corner. X 800.

3. Cystidia, one of them bifurcated; the preparation was made before massive sporulation began. X 200.

4. Digitate conidiophores, their width being about ¼ that of the cystidia shown in Fig. 3. at the same magnification. X 200.

5. Primary and secondary conidia germinating in hyphal manner or resporulating. X 200.

6. Hyphal bodies of the conidial stage and a relatively small cystidium showing septum and the intra-host part emptied of cytoplasm and collapsed (lower, left part of the figure). X 200.

(on the facing page →)

1

2

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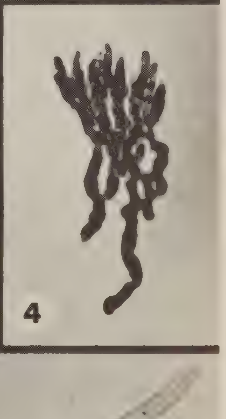
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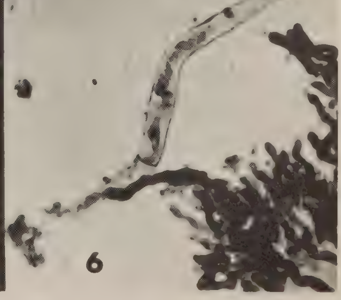
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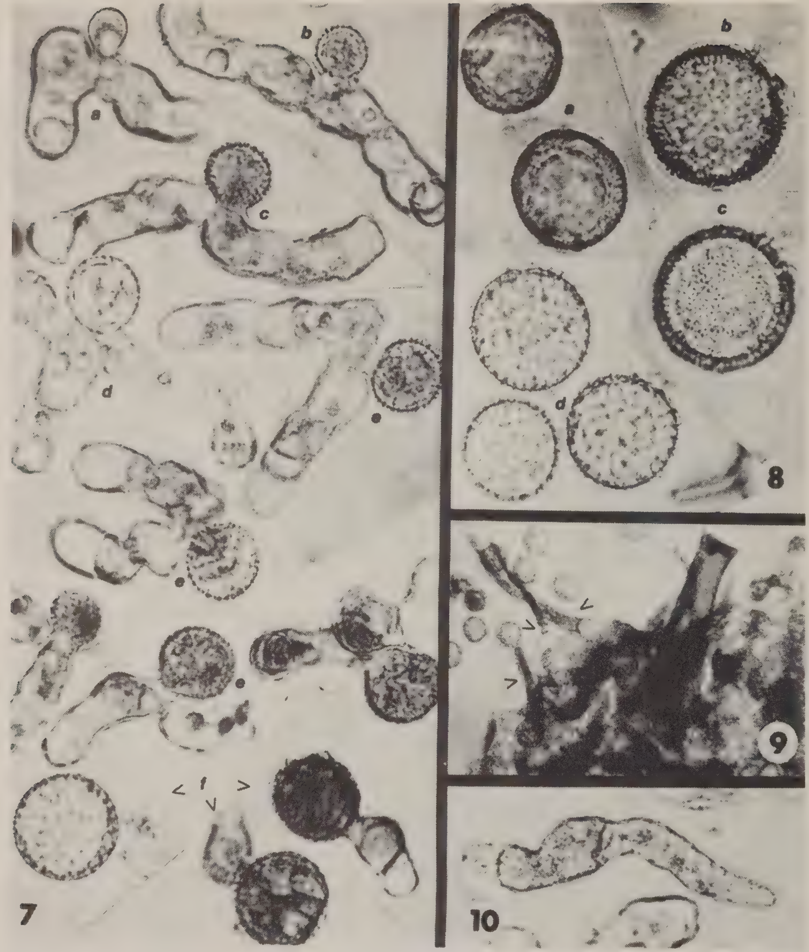

FIGURES 7-10 *Zoophthora erinacea* sp.n. zygospore stage

7 a-b-c. Consecutive early stages of conjugation of hyphal bodies and prespore growth; d-e. later stage, beginning of septation in the hyphal bodies, the distal compartments devoid of cytoplasm; f. more advanced stage, only short segments remain attached to the prespore. X 400.

8. Mature zygospores photographed at different focal distances to show: a. wall width; b. echinulation at the circumference; c. echinulation at the surface; d. echinulation on both. X 400.

9. Cystidia (arrows) on aphid with zygospores. X 100.

10. Vestigial (very short) cystidia. X 200.

(Kenneth, 1977). The germination of the secondary conidia of our fungus was similar to that of the primary ones.

As a preparation containing a homogeneous population of secondary conidia could not be obtained, 50 measurements were made from a preparation which contained many empty primary conidia (which produced secondary ones and then became emptied "ghosts") and many smaller conidia which were obviously secondary ones (Fig. 2). However, this was a heterogeneous population containing ungerminated primary conidia as well, and from it only the minimum dimensions of the secondary conidia, which are 10.3 x 6.3 µm, can be given, their maximum dimensions overlapping to an unknown extent over the lower dimensions of the primary conidia. The length/width ratio of the secondary conidia was in the same range as that of the primaries so that this index can not help to discriminate between them in a heterogeneous population.

Some of the dead aphids found on alfalfa and associated weeds during January 1979 showed the characteristic cystidia but failed to produce conidia when placed in moist chambers. They were filled with conjugating hyphal bodies and different stages of resting spore formation. The hyphal bodies conjugated terminally or laterally and the prespore was formed by budding, often very close to the point of juncture of the hyphal bodies; sometimes, however, the prespore appeared at the distal end of one of the hyphal bodies. Generally, one spore was formed by a pair of conjugating hyphal bodies. The prespore was regularly echinulate (sharp, cone-like protrusions) from the very beginning and remained so until and after maturation. After budding, the prespore grew and the nuclei of the hyphal bodies gradually passed into it. Septa were formed sequentially in the hyphal bodies from the distal ends toward the prespore, as their contents gradually passed into the growing prespore. The end of the growing process was characterised by the thickening of the prespore wall. Of the empty hyphal bodies, only small remnants remained attached to the spore. Mature spores did not stain with cotton-blue and a collar marked the point of budding (Fig. 8b-c).

Although the characteristic cystidia were not found in some aphids producing resting spores, vestigial cystidia were revealed upon dissection of these insects (Fig. 10).

Attempts to isolate and cultivate the fungus on egg-yolk medium and several rich agar media failed; it started to grow very slowly on egg-yolk, however, and this sustains the hope of future isolation.

The resemblance of the host during sporulation to a hedgehog, due to the bristling cystidia of the fungus (Fig. 1), inspired its name: *Zoophthora erinacea* (*erinaceus* = Latin for hedgehog).

IDENTIFICATION OF THE PATHOGEN

Our fungus fits in almost all respects into the genus *Zoophthora* Batko (Batko, 1964 b), by having elongate,mononucleate conidia with an outer wall which may partially separate from an inner one and by possessing digitate conidiophores (Fig. 4); the lack of rhizoids in this species would seem to be the only obstacle in placing it in *Zoophthora*. Its long and wide, sometimes bifurcate cystidia further place it in the *Zoophthora* subgenus *Erynia* (Batko, 1966), all species of which have such cystidia. In this subgenus the rhizoids are "...as thick as pseudocystides or thinner, generally without distinct foot" (Batko, 1966). According to this, some cystidia of *Z. erinacea* could be regarded as rhizoids of this subgenus although their function as rhizoids was not completely clarified by us and is still doubtful.

The entomophthoraceous species resembling most closely the one described here is *Zoophthora montana* (Thaxter)Batko, placed by Batko (1966) in the subgenus *Erynia*. The points of resemblance are its similarly shaped, mononucleate conidia, its digitate conidiophores and its very wide cystidia (Gustafsson, 1965, Figs. 104-105). However, the conidia of *Z. montana* are larger: 15-25 x 11-18 µm according to Thaxter (1888) and 17-26 x 10-19 µm according to Gustafsson (1965); it possesses true rhizoids with expanded ends (Thaxter, 1888) and was reported by both authors from Dipteran hosts only. The only other entomophthoraceous species with conidia resembling in shape those of *Z. erinacea* is *Entomophthora turbinata* Kenneth. The later species has larger conidia with 5-7 round nuclei, a greater conidial length/width ratio, and has conidia which neither germinate from both ends nor produce secondary conidia, does not form cystidia, forms simple conidiophores, and forms black, ellipsoid resting spores (Kenneth, 1977).

The identification of the resting spores as belonging to *Z. erinacea* was made only after considering the following:

1. The resting spores were present in the same species of aphids, at the same location and time, when no other entomophthoraceous fungi were present except the conidial stage of *Z. erinacea*.

2. Resting spores similar with those found by us were found in Israel in *A. fabae* and *M. persicae* by Wallis (1972), and were described as *Entomophthora aphidis* according to the resting spores of *E. aphidis* described by Gustafsson (1965). Indeed, Gustafsson's photographs (Figs. 78-82) resemble the resting spores described by us and by Wallis (1972). However, a thorough checking of Wallis' work, including his microscopic preparations, revealed that significant parts of his *E. aphidis* are *Z. erinacea* resting spores, conidia and characteristic cystidia. This explains also his claim that *E. aphidis* sometimes produces rhizoids and sometimes does not.

3. Later in January 1979 when conidia of the shape and size universally attributed to *Z. aphidis* appeared in aphid populations already infected with *Z. erinacea* (conidial and resting spore stages), smooth-walled resting spores were found in a number of individuals in which *Z. aphidis* conidia and rhizoids were also present. This further reduces the possibility of the echinulate zygospores being connected with *Z. aphidis* as claimed by Gustafsson (1965) and Wallis (1972).

4. In almost all instances, the echinulate zygospores were produced in aphids bearing the characteristic cystidia or vestigial cystidia of *Z. erinacea*.

Although absolute proof of the connection between resting spores and conidia depends upon the obtention of both in pure culture, or upon obtention of resting spores in insects artificially inoculated with conidia, the evidence appears overwhelming that the echinulate zygospores belong to *Z. erinacea*.

Of more than 15 entomophthoraceous species described from aphids, usually under the generic heading *Entomophthora* (Thoizon, 1970; Hall, 1973; and others), this is, so far, the one with the smallest conidia and the only one with occasionally bifurcate cystidia.

Z. erinacea seems to be the first species in the subgenus *Erynia* Batko (1966) known to parasitize aphids, although aphids are among the hosts of some species of two other subgenera of *Zoophthora*: - *Zoophthora* Batko and *Pandora* Batko (Batko, 1966).

ZOOPHTHORA ERINACEA BEN-ZE'EV & KENNETH SP. NOV.

Conidia symmetrica vel basem versus paulo curvata, turbinata vel obovoidea apice lato rotundato, sursum attenuata ad angustam basem papilla perparva et collo paulo prominen-

te praeditam, hyalina, mononucleata, externo pariete aliquando disjungente (basi excepta); 12.6-20.5 x 7.1-13.4 µm; per papillas vel per apicem vel per utrumque germinantia. Conidia secundaria conidiis primariis similia, minime 10.3 x 6.3 µm, conidiophoris brevibus ex conidiis primariis lateraliter ex orientibus portata. Conidia vehementer ejectilia. Conidiophora digitata, septata; 4.7-7.2 µm lata. Cystidia numerosa, longa et crassa; 150-225 (-500) x 15.8-39.5 µm, aliquando bifurcata, pre conidiophoris protrudentia. Rhizoidea verae desunt. Sporae perdurantes: plerumque zygosporae, sphaericae; 27.7-37.1 µm diametro; zygosporarum paries 4.0-7.1 µm crassus, cum episporio regulatim echinulato, subtiliter flavido. Hospites conidiophorum palisadis continuis ferrugineo-brunneis ad latera et ad partem superiorem thoracis et abdominis tecti; hospites ad substrato probosce affixi.

Conidia symmetrical or slightly curved toward the base, turbinate to obovoid, with a broadly rounded apex, tapering uniformly toward a narrow base with a small papilla and slightly prominent collar, hyaline, mononucleate, outer wall occasionally separating except at base; 12.6-20.5 x 7.1-13.4 µm; germinating through the papilla or through the apex or both. Secondary conidia resemble primary conidia; minimum 10.3 x 6.3 µm, borne on short conidiophores arising laterally from primary conidia. Conidia forcibly ejected. Conidiophores digitate, septate: 4.7-7.2 µm in width. Cystidia many, long and thick: 150-225 (-500) x 15.8 x 39.5 µm; occasionally bifurcated, protruding before conidiophores. True rhizoids absent. Resting spores: mostly zygospores, sphaerical, 27.7-37.1 µm in diameter with wall width: 4.0-7.1 µm, with a regularly echinulate, somewhat yellowish epispore. Hosts covered with a continuous rusty-brown palisade of conidiophores over the sides and upper part of the thorax and abdomen, attached to substratum by probosces.

Hosts: Rhynchota fam. Aphididae: *Aphis craccivora* Koch; *Aphis umbrella* Börner; *Aphis fabae* Scopoli; *Myzus persicae* Sulzer. Experimental host: *Aphis spiraecola* Patch. Rehovot, Israel. May 1977.

Holotype and paratype materials (microscopic preparations) are deposited at the Department of Plant Pathology and Microbiology, Faculty of Agriculture, Hebrew University, Rehovot, Israel.

DISCUSSION

In using the generic name *Zoophthora* (Batko, 1964 b)for this species and placing it within the subgenus *Erynia* (Batko, 1966) we have adopted part of Batko's taxonomical classification of Entomophthoraceae. Batko was by no means the first to attempt to divide the genus *Entomophthora* Fresenius into various groupings, and Roland Thaxter (1888) already had proposed subgenus status for some groups of species, e.g. *Triplosporium.*

The many continuing efforts to find natural groupings for the ever more unwieldy genus *Entomophthora* Fresenius, burdened with new members and displaying great differences among some species, is in itself evidence for the need to do so.

Admittedly, some of these attempts have resulted in more taxonomic and nomenclatural confusion than before, but greater insights into group relationships have eventually developed because of these attempts and in spite of any confusion.

Batko's treatment (1964 a, b, c, d; 1966; Batko and Weiser, 1965), in which *Entomophthora* Fresenius (*sensu lato*) was broken into five genera, seems to be the most logical system yet worked out, although we believe it needs considerable changes regarding some genera and subgenera in the scheme. Of his five genera (*Entomophaga*, *Entomophthora*, *Culicicola*, *Triplosporium* and *Zoophthora*), some appear to be heterogeneous and therefore faulty, since certain species attributed by him to *Entomophaga* could be accomodated in *Conidiobolus* Brefeld whereas all species attributed to *Culicicola* seem to belong either to *Conidiobolus* or to *Entomophthora* (*sensu stricto* or *sensu* Batko)(R. Humber, personal communication); we leave this problem for specialists in *Conidiobolus* taxonomy.

The genera *Zoophthora* and *Triplosporium* (Batko, 1964 b), however, are so distinct from other groups and so well defined that we believe that there is no sense in hesitating any longer in using them. One problem that must eventually be solved is where to place entomophthoraceous species such as *Entomophthora turbinata* (Kenneth, 1977), which fit into none of the above-mentioned genera nor into the widely accepted genera *Massospora* Peck (*emend.* Soper)(Soper, 1974) or *Strongwellsea* Batko & Weiser (*emend.* Humber)(Humber, 1976). Apparently, new genera will have to be erected to accommodate them.

It is more problematic to find a refuge (hopefully only temporarily) for those species in which not all characters are known well enough to allow them to be sorted into one of the above genera. They could be kept, meanwhile, in *Entomophthora* Fresenius *sensu lato*. Batko (1964 a) had retained *Entomophthora* among his five genera as "*Entomophthora* Fresenius *non* Nowakowski", for only a limited number of species resembling *E. muscae*. Its acceptance in that meaning would result in confusion, unless it is emphasized for each fungus in this group whether one is referring to the genus in its wide sense (as a temporary refuge) or narrow one (*s.s.* or *sensu* Batko).

Minor emendations might have to be made in the diagnoses of *Zoophthora* and *Triplosporium* in order to accomodate a few slightly divergent species. As an example, *Entomophthora parvispora* MacLeod & Carl (MacLeod *et al.*,1976) appears to be an excellent *Triplosporium*, except for its hyaline, rather than fuliginous conidia. If smoky conidia were to be deleted as a necessary character for this genus, *E. parvispora* would fit well into that genus and still allow *Triplosporium* to remain quite distinct from all other genera, to judge from Batko and Weiser's (1965) Table 1 "Comparative characteristics of zoophilic genera of Entomophthoraceae". Similarly, *Z. erinacea* is missing one of the hallmarks of a typical *Zoophthora*, - rhizoids. As explained earlier, one of Batko's (1966) four subgenera within that genus, *Erynia*, could accomodate our species, as the rhizoids, according to him, may be as thick as the very thick cystidia, and are generally without a distinct foot. This could correspond to some of the long, wide cystidia of *Z. erinacea*. Unlike in species of Batko's subgenus *Pandora*, in which the rhizoids and cystidia are highly differentiated (Brobyn and Wilding, 1977) and therefore easily distinguished, it is a matter of interpretation here over what constitutes a rhizoid; we take the view that it is not a true one, but that in this species some cystidia might be making the transition to rhizoids.

We can not vouch for the validity of Batko's other subgenera within the genus *Zoophthora*, although they all appear distinct from each other and from *Erynia*. The subgenus *Zoophthora* includes species which form capillispores (anadhesive conidia) at the apex of thin capillary conidiophores on primary conidia, as well as species which have never been shown to form these structures. We doubt that these two kinds of species belong together in one subgenus. Batko (1966) refers to:"rhizoids thin, threadlike, unbranched, not widened at ends, aggregated in pseudorhizomorphs". Thaxter (1888) showed clearly (Plate 17, Fig.179) a monohyphal "rhizoid with irregularly expanded extremity" for *E. occidentalis*, a species which belongs to this subgenus according to Batko (1964 b); we found, in the "sphaerosperma group" of which *Z.(E.) occidentalis* is one species, thin, monohyphal rhizoids along with multihyphal pseudorhizomorphs occurring on the same individual host, with either of them having a definitely broad, disc-shaped or irregularly expanded foot. Batko's diagnosis for *Zoophthora* subgen. *Zoophthora* will have to be emended, as we intend doing.

AKNOWLEDGMENTS

This research was supported in part by grant No. 744 from the United States - Israel Binational Science Foundation and 'The Fund for the Encouragement of Research' — Histadrut—The General Federation of Labour in Israel. We are grateful to Dr. Irene Gruenberg-Fertig, Hebrew University, and to Prof. E.D. Kollman, Tel-Aviv University, for the Latin diagnosis. We also thank Agron. S. Bitton, Hebrew University, for permission to cite his findings on infection of *A. spiraecola* by *Z. erinacea*. We are particularly grateful to Dr. Richard Humber for his very valuable criticisms and insights.

REFERENCES

Batko, A. 1964 a. Remarks on the genus *Entomophthora* Fresenius 1856 *non* Nowakowski 1883 (Phycomycetes: Entomophthoraceae). Bull. Acad. Polon. Sci., Ser. Sci. Biol. 12(7):319-321.

Batko, A. 1964 b. On the new genera: *Zoophthora* gen. nov., *Triplosporium* (Thaxter) gen. nov. and *Entomophaga* gen. nov. (Phycomycetes: Entomophthoraceae). Bull. Acad. Polon. Sci., Ser. Sci. Biol. 12(7):323-326.

Batko, A. 1964 c. Remarks on the genus *Lamia* Nowakowski 1883 vs. *Culicicola* Niewland 1916 (Phycomycetes: Entomophthoraceae). Bull. Acad. Polon. Sci., Ser. Sci. Biol. 12(9):399-402.

Batko, A. 1964 d. Some new combinations in the fungus family Entomophthoraceae (Phycomycetes). Bull. Acad. Polon. Sci., Ser. Sci. Biol. 12(9):403-406.

Batko, A. 1966. On the subgenera of the fungus genus *Zoophthora* Batko 1964 (Entomophthoraceae). Acta Mycol. 2:15-21.

Batko, A. and J. Weiser, 1965. On the taxonomic position of the fungus discovered by Strong, Wells and Apple: *Strongwellsea castrans* gen. et sp. nov. (Phycomycetes: Entomophthoraceae). J. Invertebr. Pathol. 7:455-463.

Bitton, S. 1978. Observations and studies on the biology of fungi belonging to the genus *Entomophthora* (Phycomycetes: Entomophthoraceae) attacking *Aphis spiraecola* Patch. M.Sc. thesis, Hebrew Univ. (Hebrew, Engl. summ.).

Brobyn, P. and N. Wilding, 1977. Invasive and developmental processes of *Entomophthora* species infecting aphids. Trans. Br. Mycol. Soc. 69(3):349-366.

Gustafsson, M. 1965. On species of the genus *Entomophthora* Fres. in Sweden. I. Classification and distribution. Lantbrukshögskölans. Ann. 31:103-212.

Hall, I.M. 1973. Pathogens of aphids. in "Perspectives in Aphid Biology" (ed. A.D. Lowe) Entom. Soc. of New Zealand, Auckland: 30-40.

Humber, R.A. 1976. The systematics of the genus *Strongwellsea* (Zygomycetes: Entomophthorales). Mycologia 68:1042-1060.

Kenneth, R.G. 1977. *Entomophthora turbinata* sp. n., a fungal parasite of the peach trunk aphid, *Pterochloroides persicae* (Lachnidae). Mycotaxon 4(2):381-390.

Lakon, G. 1919. Die Insectenfeinde aus der Familie der Entomophthoreen. Z. Angew. Entomol. 5(2):161-215.

MacLeod, D.M., D. Tyrrell and K.P. Karl, 1976. *Entomophthora parvispora* sp. nov., a pathogen of *Thrips tabaci*. Entomophaga 21(3):307-312.

Soper, R.S. 1974. The genus *Massospora* entomopathogenic for cicadas. Part I. Taxonomy of the genus. Mycotaxon 1:13-40.

Thaxter, R. 1888. The Entomophthoreae of the United States. Memoirs Boston Soc. Nat. Hist. 4:629-678.

Thoizon, G. 1970. Specificite du parasitisme des Aphides par les Entomophthorales. Ann. Soc. Entomol. France, n.s. 6:517-562.

Wallis, G. 1972. Survey of fungi attacking insects in Israel. M.Sc. thesis, Hebrew Univ. (Hebrew).

MYCOTAXON

Vol. X, No. 1, pp. 233-240 October-December 1979

BLISTUM MUSAE: A NEW SPECIES OF SYNNEMATAL HYPHOMYCETE[1]

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During a damp chamber experiment a cluster of about ten synnemata grew on the outer surface of a banana peel which had been incubated at room temperature for sixteen days. Microscopic examination suggested that the fungus was a member of the genus Blistum Sutton (1973), but was not one of the species previously described. Attempts to culture the fungus on 2% malt agar, potato dextrose agar, and sterilized banana peel were unsuccessful.

The status of the generic names Stilbella, Stilbum and Blistum was clarified by Sutton (1973). Stilbum is the valid name applied to a Basidiomycete genus and Stilbella is used for a hyphomycete genus characterized by smooth, white to cream, unbranched, erect synnemata, with distinct monophialidic apertures and globose, hyaline, aseptate conidia. Blistum is distinguished from Stilbella by the lateral or terminal projections ornamenting the stipe of the synnemata.

The new species Blistum musae is described, and Blistum orbiculare (Berk. & Br.) Ing, transferred to the genus by Ing (1976), is redescribed and illustrated. Because the ornamentations of B. musae and B. orbiculare and the arrangement of the phialides of *B. musae* differ from those in the generic description of Sutton (1973), the description of *Blistum* is emended.

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Blistum emend. nov.

Mycelium immersed or superficial, hyaline, branched, septate. *Conidiophores* macronematous, synnematous. *Synnemata* erect, unbranched, creamy white with a capitate head, ornamented along the side by hyaline projections, which may or may not be delimited by a septum. *Conidiogenous cells* monophialidic, integrated or discrete, lateral, terminal, or verticilliate, determinate, hyaline. *Conidia* slimy, acrogenous, simple, hyaline, aseptate.

Blistum musae sp. nov.

Mycelium immersum, ex hyphis hyalinis, ramosis, septatis, compositum. *Conidiophora* synnematosa, recta, non ramosa, alba, apice capitato, 1100µm longa et 60-160µm crassa, cum irregularis, hyalinis, ornata minor 2µm. *Cellulae conidiogenae* monophialidicae, in conidiophoris incorporatae laterales, vel terminales, discretae, determinatae, hyalinae, attenuatae, 20-35µm longae, 2-3µm in diametro in basis, 1-2µm in apice. *Conidia* mucosa, acrogena, hyalina, aseptata, ellipsoidea vel cylindrica, 6-7x1.5-2µm.

Mycelium immersed in substrate, composed of branched septate, hyaline hyphae. *Synnematal conidiomata* gregarious, white, unbranched, erect, straight, brittle when dry, up to 1100µm long x 60-160µm thick, of uniform thickness, when mounted the apex may splay out to form capitate head 220µm wide x 95µm long, individual hyphae hyaline, branched, septate, smooth-walled, interwoven, 1-2µm in diameter, ornamented in the upper half of the stipe by hyaline, lateral or terminal, irregular or three- or four-lobed projections, usually less than 2µm x 2µm. *Conidiogenous cells* monophialidic, lateral or terminal, occurring only at the apex of the synnema, discrete, determinate, subulate, hyaline, with narrow apical aper-

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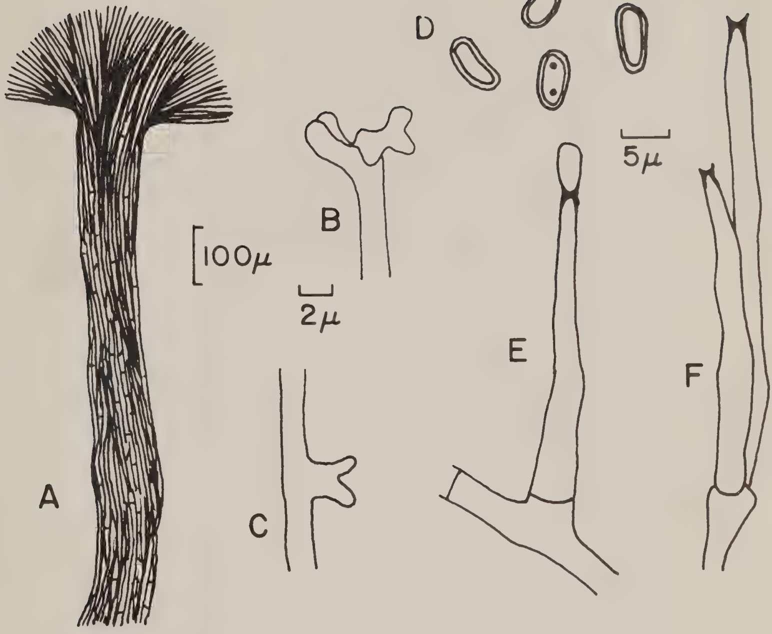
Figure 1: A-F) *B. musae* IMI 235790 A) Synnema B) lateral phialide with developing conidium C) conidia D) terminal ornamentations E) lateral ornamentation.

Figure 2: A-D) *B. orbiculare* from type collection A) synnema B) phialide with developing conidium C) conidia D) ornamenting cells.


D
B
100μ
2μ
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E
F
A
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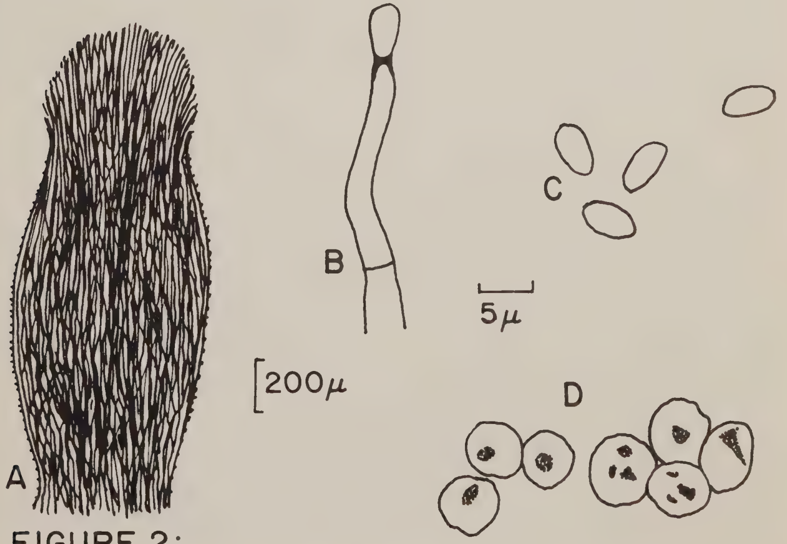
FIGURE 1:


B
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200μ
D
A

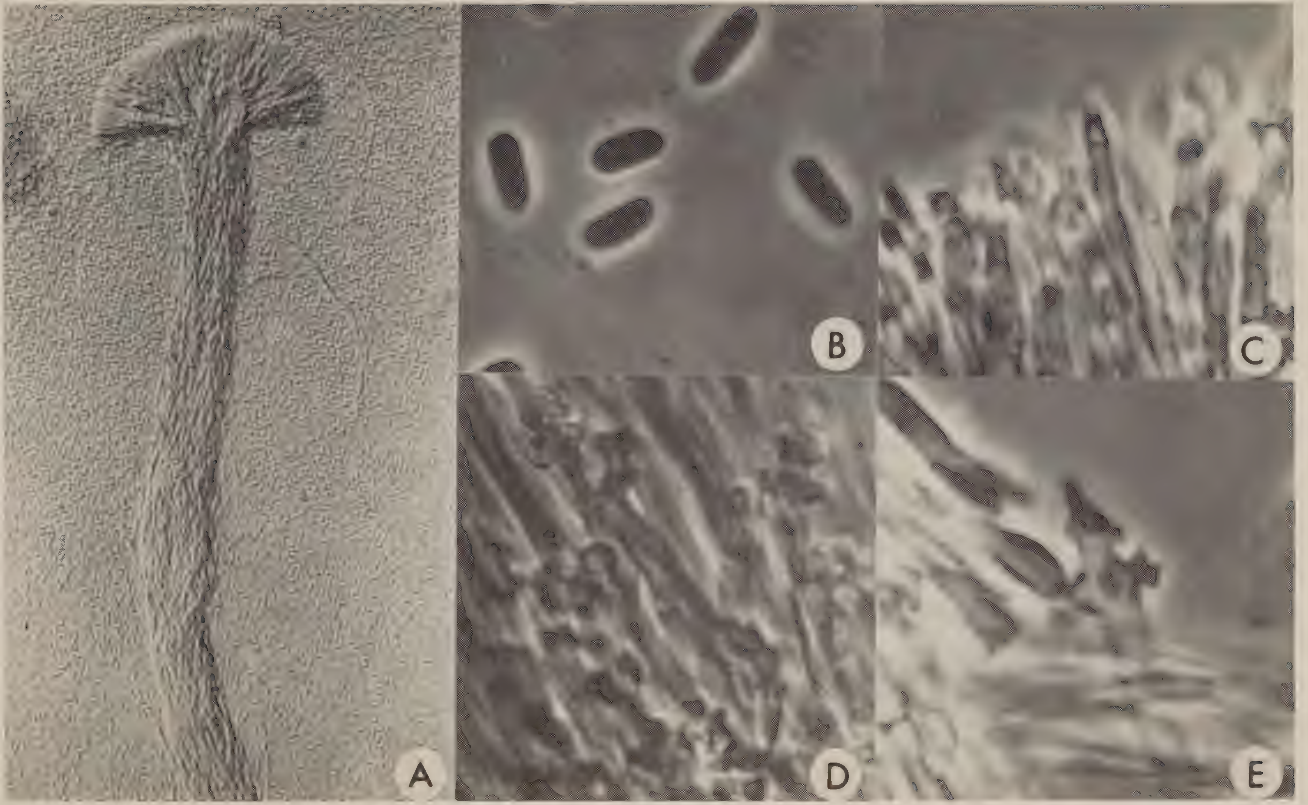
FIGURE 2:

ture, with distinct collarettes, 20-35μm long, 2-3μm in diameter at base, 1-2μm at apex. Conidia aggregated in globose, pale orange to red, mucoid heads, individual conidia ellipsoid to cylindrical, sometimes slightly reniform, aseptate, hyaline, walls slightly thickened, two to four guttulate, light walled with darker cytoplasm under phase contrast, sometimes losing cytoplasm, 6-7μmx1.5-2μm. Habitat: skin of *Musa* fruit consocio *Verticillium*, *Acremonium*.
Holotype: IMI 235790, isolated January 29, 1979 at
University of Waterloo, Waterloo, Canada
Material examined: IMI 235790
isotype material in DAOM

Several features distinguish *Blistum musae* from *B. tomentosum* (Scrad. ex Fr.) Sutton, the type species, and from *B. ovalisporum* (A.L. Smith) Sutton and *B. orbiculare*. Instead of covering the entire synnema as in other *Blistum* species, the ornamentations of *B. musae* are present only on the upper half, concentrated on the captitate head, and visible only at high magnification. The ornamentations are much smaller, morphologically quite irregular, and apparently not delimited by a septum. The ornamentations appear to be restricted to the surface of the synnema. Other members of the genus are typically parasitic on myxomycetes, but *B. musae* was detected on the skin of *Musa* fruit. The phialides of *B. musae* are lateral or terminal, and discrete, whereas those of other members of the genus are either integrated and terminal, or discrete and verticilliate.

Blistum orbiculare (Berk. & Br.) Ing, Bull. Br. mycol. Soc. *10*(1):30 (1976)
Stilbum orbiculare Berk. & Br., Ann. Mag. Nat. Hist. Ser. 5, *1*:28 (1878)
Stilbella orbicularis (Berk. & Br.) W.Gams, *Cephalosporium-artige Schimmelpilze (Hyphomycetes)*. p. 230 (1971)

Plate 1: A-F) *B. musae* IMI 235790 A) synnema 90X
B) conidia 2000X C) phialide at apex of synnema 2000X
D) terminal and lateral ornamentations of hypha 1750X
E) portion of synnematal head showing texture due to ornamentations 2000X.


A
B
C
D
E

Mycelium immersed in substrate, composed of branched, septate, hyaline hyphae. *Synnematal conidiomata* gregarious, stained brown by host, unbranched, erect, sometimes drooping, flattened, brittle when dry, 1500-2300µm long, 500-800µm thick, often thicker in centre of stipe than at base, tapering then expanding to the apex, individual hyphae hyaline, branched, septate, smooth-walled, interwoven, 1-2µm in diameter, entire stipe ornamented with globose to subglobose hyaline, guttulate, projecting cells, easily dislodged when dry, 4-5µmx 4-6(10)µm. *Conidiogenous* cells monophialidic, terminal or verticilliate, occurring only at apex, discrete, cylindrical, hyaline, 20µm long, 1-2µm in diameter. *Conidia* ellipsoid, aseptate, hyaline, thin-walled, 2x4-5µm.

Material examined: Type collection of *Stilbum orbiculare* of Rev. J. Keith on *Lindbladia effusa*, in Herb. Berkeley, Kew.

Blistum orbiculare was transferred to *Blistum* from *Stilbella* by Ing (1976), but he neglected to give details of the characteristic ornamentations which, though previously undescribed, were mentioned by Berkeley and Broome (1878). The synnemata of *B. orbiculare* are originally white (Berkeley & Broome 1878, Cejp 1964, Karsten 1887) and are stained brown by the host (Berkeley & Broome 1878). The conidia are held in globose or ovoid, white to yellow, translucent mucoid heads, 120µm in diameter (Cejp 1964, Karsten 1887). The synnemata of the type collection vary considerably in size, which accounts for the range of measurements found in previous descriptions. Phialides are difficult to distinguish even under phase contrast, and conidia are few on the type collection. The ornamenting cells are extremely numerous and easily dislodged during mounting, which explains the felt-like consistency of the stipe noted by previous authors (Berkeley & Broome 1878, Cejp 1964). The ornamentations might easily be mistaken for conidia or spores of the host. Gams (1971) observed that in pure culture *B. orbiculare* rapidly loses its ability to form synnemata.

The fungus has been reported in the literature as parasitizing the following myxomycete genera: *Lindbladia*, *Fuligo*, *Trichia* (Gams 1971), *Fulgine* (Karsten 1887), *Arcyria*, *Hemiarcyria*, *Didymium*, *Dictydium*,

Table I: A comparison of *Blistum* species

Species	Synnema		Ornamentation		Conidia	
	length (μm)	width(μm)	nature	size(μm)	shape	size (μm)
B. musae	1100	60-160	irregular	1-2	ellipsoidal	1.5-2x6-7
B. orbiculare	1500-2300	500-800	globose guttulate	4-5	ellipsoidal	2x4-5
B. ovalisporium	200	15-20	globose verrucose	3-4	ellipsoidal	1-1.5x2.5-4
B. tomentosum	1000	60-70	globose verrucose	3-4	globose	1-1.5

Cribraria, Lachnobolus and Stemonitis (Cejp 1964). On the bases of some of the synnemata of the type collection, I found a hyperparasite, most likely a species of Nematogonium.

Table I is included as an aid to the quick identification of the four species accepted in Blistum.

ACKNOWLEDGEMENTS: I am indebted to Dr. Bryce Kendrick, S. Berch, F. DiCosmo, J. Michaelides, Dr. Ian Reid, Dr. Reg Haskins, and Dr. B.C. Sutton for suggestions and encouragement. L.R. Nesbitt and E. Knapp are thanked for assistance preparing illustrations.

REFERENCES

1. Berkeley, M.J. and C.E. Broome (1878). Notices of British Fungi. Ann. Mag. Nat. Hist. Ser. V. vol I; 17-30.

2. Cejp, K. (1964). Tilachlidium tomentosum (Schrad.) Lindau, a parasite of slime molds in Bohemia. Ces. Mycol. 18; 180-182.

3. Gams, W. (1971). Cephalosporium-artige Schimmelpilze (Hyphomycetes). Gustav Fischer Verlag, Stuttgart, p. 230.

4. Ing, B. (1973). More on Mouldy Myxomycetes. Bull. Brit. mycol. Soc. 10(1); 30.

5. Karsten, P.A. (1887). Symbolae dmycologiam fennicaem. Meddel. Soc. Fauna Fl. fenn. 14; 78-94.

6. Sutton, B.C. (1973). Hyphomycetes from Manitoba and Saskatchewan. Mycol. Pap. 132; 16-20.

MYCOTAXON

Vol. X, No. 1, pp. 241-245 October-December 1979

Phacidiales Exsiccati
Decades I-III

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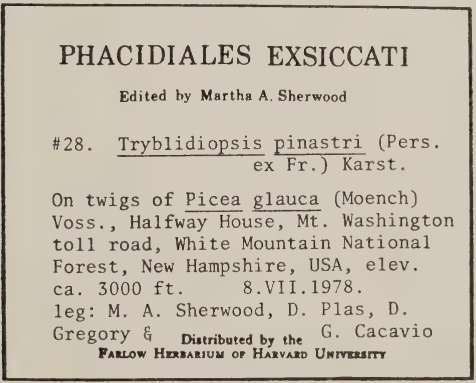
In order to further knowledge of the morphology, taxonomy, and geographical distribution of immersed discomycetes, the author has undertaken the preparation of an exsiccata, Phacidiales Exsiccati, the first thirty numbers of which were offered for distribution in July, 1979.

The principal aim of the exsiccata is to make available type and authentic specimens documenting the author's researches in this group of fungi (Sherwood, 1974a; 1974b; 1977a; 1977b; 1977c; 1979), examples of infrequently collected species, specimens representing significant range extensions, and examples of species which are commonly misidentified or represented by mixed collections in herbaria.

The term Phacidiales has been used in a very broad sense for a taxonomically heterogeneous group of fungi distinguished by their immersed growth habit and ecology. The first thirty numbers include members of the Stictidaceae, Rhytismataceae (including Hypodermataceae), Hemiphacidiaceae, Acrospermataceae, Leotiaceae, and a number of species whose family affinities are uncertain.

The printed labels attached to the packets have the format shown in figure 1. Annotation labels have been included in some of the packets.



PHACIDIALES EXSICCATI

Edited by Martha A. Sherwood

#28. Tryblidiopsis pinastri (Pers. ex Fr.) Karst.

On twigs of Picea glauca (Moench) Voss., Halfway House, Mt. Washington toll road, White Mountain National Forest, New Hampshire, USA, elev. ca. 3000 ft. 8.VII.1978.
leg: M. A. Sherwood, D. Plas, D. Gregory & G. Cacavio

Distributed by the
FARLOW HERBARIUM OF HARVARD UNIVERSITY

Figure 1. Facsimile label from Phacidiales Exsiccati.

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The species and localities of the collections are as follows (label data is quoted verbatim):

(1). *Robergea nigra* Sherwood, on living and dead twigs of *Lonicera involucrata* (Rich.) Banks ex Spreng., Devil's punchbowl State Park, Lincoln Co., Oregon, USA, 9.VIII.1978, leg. & det. M. A. Sherwood (Authentic, from type locality).
(2). *Coccomyces leptideus* (Fr.) B. Erikss., on living and dead twigs of *Gaultheria shallon* Pursh, wet forest 2 mi. N. of Yachats, Lincoln Co., Oregon, elev. ca. 50 ft., 10-12. VIII.1978, leg. & det. M. A. Sherwood (=*Coccomyces quadratus* (Schm. & Kunze) Sacc. Parasitic, causing dieback. Fairly common on this host in the Pacific Northwest. Collection date erroneously given as 10-12.VIII.1979 on label).
(3). *Myriophacidium aphyophyllicum* Sherwood, on fallen leaves of *Castanopsis chrysophylla* (Doug. ex Hook.) A. DC, junction roads 1500 and 1500-134, H. J. Andrews Experimental Forest, ca. 15 mi. NE of Blue River, Lane Co., Oregon, USA, 8.VIII.1978, leg. & det. M. A. Sherwood. (Authentic. Collected about 4 miles from the type locality, which has since been clearcut).
(4). *Coccomyces tumidus* (Fr.) de Not., on last year's fallen leaves of *Quercus rubra* L., Estabrook woods, Concord, Massachusetts, USA, 17.IX.1978, leg. D. H. Pfister, det. M. A. Sherwood. (Not a synonym of *Lophodermium tumidum* (Fr.) Rehm sensu Rehm, or of *Coccomyces coronatus* (Fr.) de Not. This is the type species of *Coccomyces*).
(5). *Robergea albicedrae* (Heald & Wolf) Sacc. & Trav., on twigs of *Juniperus ashei* Buchholz, junct. State Hwy 71 and Ranch Road 620, Edwards Plateau, Travis Co., Texas, USA, 26. IX.1978, leg. John J. Biesele, det. M. A. Sherwood.
(6). *Fabrella tsugae* (Farl.) Kirschst., on dead needles of *Tsuga canadensis* (L) Carr. still attached to twigs, Ringwood Preserve, Tompkins Co., New York, USA, 15.VI.1978, leg. & det. M. A. Sherwood (Parasitic, often found on dead needles mixed with living needles on the same twig. Very common, particularly on suppressed understory trees).
(7). *Stictis radiata* Pers., on dead canes of *Rubus parviflorus* Nutt., Hendrick's Park, Eugene, Oregon, USA, 5.VIII.1978, leg. & det. M. A. Sherwood.
(8). *Eupropolella vaccinii* (Rehm) Höhnel, on dead leaves of *Arctostaphylos uva-ursi*, Reference Stand 14, Wildcat Mountain, Willamette National Forest, Linn Co., Oregon, elev. 5200 ft., 18.VIII.1978, leg. M. A. Sherwood, L. H. Pike, & G. Chrones, det. M. A. Sherwood.
(9). *Lophodermium decorum* Darker, on living *Abies procera* Rehder, Reference Stand 14, Wildcat Mountain, Willamette National Forest, Linn Co., Oregon, USA, elev. 5200 ft., 18. VIII.1978, leg. M. Sherwood, L. H. Pike, & G. Chrones, det. Sherwood.
(10). *Therrya fuckelii* (Rehm) Kujala, on dead branches of *Pinus resinosa* Ait., Kancamangus Hwy 10 mi. W. of Conway, White Mountain National Forest, New Hampshire, elev. ca 1000 ft., 23.VII.1978, leg. M. A. Sherwood & E. J. Kneiper, det. M. A. Sherwood.
(11). *Bifusella linearis* (Peck) Höhnel, on *Pinus strobus* L, Weirs, New Hampshire, 4.VII.1934, leg. & det. G. D. Darker

nr. 5024.

(12). *Rhabdocline weirii* Parker & Reid subsp. *obovata* Parker & Reid, on *Pseudotsuga menziesii* (Mirb.) Franco, Floral Hill Drive, Eugene, Oregon, USA, VI.1978, leg. & det. G. C. Carrol.

(13). *Tryblidium alpinum* (Hazsl.) Rehm, on *Vaccinium ovatum* Pursh, associated with dieback, stabilized sand dune area between hwy 101 and Clear Lake, 4 mi. N. of Florence, Lane Co., Oregon, elev. ca. 50', 14.III.1979, leg. M. A. Sherwood & L. H. Pike, det. M. A. Sherwood. (The identification is tentative. Does not correspond to the description of any fungus known to occur on this host in North America, or to any species found on Ericaceae by B. Eriksson (1970) in Fennoscandia).

(14). *Lasiostictis fimbriata* (Schw.) Bäuml., on cone scales of *Pinus resinosa* Ait., North Truro, Cape Cod, Massachusetts, USA, 25.VI.1978, leg. M. A. Sherwood nr. 2431, det. M. A.S.

(15). *Lophodermium arundinaceum* (Schrad. ex Fr.) Chev., on *Ammophila arenaria* (L) Link, 2 mi. N. of Yachats, Lincoln Co., Oregon, USA, elev. 20 ft. August 10-12, 1978, leg. & det. M. A. Sherwood.

(16). *Coccomyces delta* (Schm. & Kunze) Sacc., on leaves of Lauraceae, São Miguel, Hickling Park, Furnas, Azores, 5.IV. 1978, leg. R. P. Korf, L. M. Kohn, N. Korf & A. Y. Rossman, det. M. A. Sherwood (= CUP, Mycoflora Macaronesia 1845).

(17). *Agyrium rufum* (Pers.) Fr., on decorticated conifer wood, Pacific Crest trail crossing at Santiam Summit, Linn County, Oregon, USA, elev. 4800 ft. 15.VIII.1978, leg. M. A. Sherwood & L. H. Pike, det. M. A. Sherwood.

(18). *Rhytisma acerinum* Pers. ex Fr., tar spot, on fallen leaves of *Acer rubrum* L. Ottawa National Forest, Upper Michigan, October 5, 1978, leg. & det. R. W. Stack. (Leaves were artificially overwintered for 160 days at 4°c).

(19). *Coccomyces strobi* Reid & Cain, very common on recently dead twigs of *Pinus strobus* L., Estabrook Woods, Concord, Massachusetts, 31.V.1978, leg. & det. M. A. Sherwood.

(20). *Coccomyces dentatus* (Schm. & Kunze) Sacc., common on fallen leaves of *Berberis nervosa* Pursh, Watershed 20, H. J. Andrews Experimental Forest, Willamette National Forest, Lane Co., Oregon, USA, 9.VIII.1978, leg. & det. M. A. Sherwood.

(21). *Acrospermum gaminum* Libert, on culms and leaves of *Dactylis glomerata* L., Corvallis, Oregon, 9.III.1979, leg. M. A. Sherwood & W. C. Denison, det. M.A.S.

(22). *Discocainia treleasei* (Sacc.) J. Reid & Funk, on recently dead bark of *Picea sitchensis* (Boug.) Carr., Cascade Head, Tillamook Co., Oregon, 20.III.1979, leg. M. A. Sherwood & W. C. Denison, det. M.A.S. (This material is slightly immature but shows developmental stages well. Label incorrectly gives collection date as 30.III.1979).

(23). *Pseudographis* cfr. *elatina* (Ach.) Nyl., on bark of *Pseudotsuga menziesii* (Mirb.) Franco, Reference Stand 20, H. J. Andrews Experimental Forest, Willamette National Forest, Lane Co., Oregon, USA, 8.VIII.1978, leg. & det. M. A. Sherwood.

(24). *Stictis radiata* Pers. var. *aggregata* Sherwood, on *Pyrus*-like tree, Corral, Chile, December, 1905, leg. R. Thaxter, det. M. A. Sherwood, ISOTYPE of the variety (see Occ. Pap. Farlow Herbarium 14: (1979).
(25). *Stictis ostropoides* Sherwood, on *Lonicera* sp., Devil's Punchbowl State Park, Lincoln Co., Oregon, USA, 9.VIII.1978, leg. & det. M. A. Sherwood (authentic).
(26). *Durella atrocyanea* (Fr.) Höhnel, Horse Rock Ridge, ca. 15 mi. N.E. of Marcola, Linn Co., Oregon, USA, elev. 450 m. 21.III.1979, leg. M. A. Sherwood, L. H. Pike & D. Wagner, det. M.A.S. (On *Arbutus menziesii* Pursh).
(27). *Lophodermium uncinatum* Darker, on dead needles of *Abies procera* Rehder, RS-14, Wildcat Mountain, Willamette National Forest, Linn Co., Oregon, USA, elev. 5200', 18.VIII. 1978, leg. M. A. Sherwood, L. H. Pike & G. Chrones, det. MAS.
(28). *Tryblidiopsis pinastri* (Pers. ex Fr.) Karst., on twigs of *Picea glauca* (Moench) Voss, Halfway House, Mount Washington toll road, White Mountain National Forest, New Hampshire, USA, elev. ca. 3000 ft., 8.VII.1978, leg. M. A. Sherwood, D. Plas, D. Gregory & G. Cacavio, det. M.A.S. (Spores of the Eastern North American specimens are smaller than spores of European examples of this species. The affinities of *Tryblidiopsis* appear to lie with the wood-inhabiting species of *Coccomyces*).
(29). *Coccomyces irretitus* Sherwood, on bark of *Picea* sp., Seal Cove Road, Acadia National Park, Mt. Desert Island, Maine, 16.VI.1979, leg. & det. M. A. Sherwood. (ISOTYPE of species to be published in Occ. Pap. Farlow Herbarium 15. A nomen nudum here).
(30). *Lophodermium pinastri* (Pers. ex Fr.) Chev., on fallen needles of *Pinus resinosa* Ait., North Truro, Cape Cod, Massachusetts, USA, 25.VI.1978, leg. & det. M. A. Sherwood.

The first thirty numbers of Phacidiales Exsiccati were distributed through the exchange program of the Farlow Herbarium. Future decades will probably be distributed through other channels.

Decades I-III of Phacidiales Exsiccati have been distributed to the following herbaria (Abbreviations are taken from Holmgren & Keuken, 1974): FH, DAOM, UPS, UC, NY, IMI, O, PRM, and ZT.

Acknowledgements

The author would like to thank several collectors, whose names appear in the list of specimens above, for generously contributing material for distribution or providing collecting assistance. Several herbaria loaned specimens on which determinations are based; for further details see Sherwood (1979). Donald Pfister (FH), the author's supervisor, offered help and encouragement throughout the course of the project. The costs of processing, labelling, and distributing the specimens were met by the Farlow Herbarium and by NSF grant DEB 72-02503-A04 to Harvard University Herbaria.

References cited

Eriksson, B. (1970). On Ascomycetes on Diapensales and Ericales in Fennoscandia. Symb. Bot. Upsal. 19(4): 1-171 + VI pl.

Holmgren, P. K. & W. Keuken (1974). Index Herbariorum. Utrecht. 397 p.

Sherwood, M. A. (1974a). Myriophacidium, a new genus of Rhytismataceae from western Oregon. Mycologia 66: 690-692.

______________ (1974b). Taxonomic studies in the Phacidiales. Stictis maritima and the genus Lasiostictis. Mycotaxon 1: 41-44.

______________ (1977a). The Ostropalean fungi. Mycotaxon 5: 1-277.

______________ (1977b). Taxonomic studies in the Phacidiales: Propolis and Propolomyces. Mycotaxon 5: 320-330.

______________ (1977c). The Ostropalean fungi II. Schizoxylon, with notes on Stictis, Acarosporina, Coccopeziza, and Carestiella. Mycotaxon 6: 215-260.

______________ (1979). Taxonomic studies in the Phacidiales: The genus Coccomyces. Occ. Pap. Farlow Herbarium 15: (in press).

MYCOTAXON

Vol. X, No. 1, pp. 246-250 October-December 1979

PITHOMYCES FUNICULOSA SP. NOV. FROM FUNGAL COMB OF MACROTERMES UKUZII IN SWAZILAND

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During a study of fungi occurring in fungal comb in mounds of *Macrotermes ukuzii* Fuller (Termitidae, Isoptera) in Luyengo, Swaziland, a fungus was isolated which was determined to belong to the genus *Pithomyces* Berk. & Br. (Hyphomycetes, Deuteromycotina) (Ellis, 1960,1976). It differs from previously described species and is herein described as new.

Spore size ranges and means are based on measurements of 50 spores taken from colonies grown on 3% malt agar (pH 5.5) at 27°C. Colonies were irradiated 12 hours/day with Sylvania F15T8-BLB "Blacklight Blue" bulbs which emit near-ultraviolet wavelengths. Anatomical features were described from sections of colonies mounted in glycerin and water (40/60,v/v). Collections are deposited in MPPD and CUP.

Pithomyces funiculosa Palm, Stewart, & Rossman sp. nov.
Figs. 1-3

COLONIAE in agaro hordeano juniores albidae vel fumosae; vetustiores brunneae vel anthracinae. CONIDIOPHORA et HYPHAE plerumque funiculosa, denticulata. CELLULAE CONIDIOGENAE holoblasticae. CONIDIA levia vel verruculosa, luteo-brunnea vel atrobrunnea, septis transversis (0-) 1-3 (-4), plerumque 2-septata, raro 1-2 septis obliquis vel longitudinalibus praesentibus; conidia 1-septata 10-17 ($\bar{x}$ = 13.9) x 6-12 ($\bar{x}$ = 8.5) µm, 2-septata 14-23 ($\bar{x}$ = 18.6) x 7-12 ($\bar{x}$ = 9) µm, 3-septata 17-25 ($\bar{x}$ = 21.2) x 7-12 ($\bar{x}$ = 9) µm. Holotypus Rossman #1429 (MPPD), isotypus Rossman #1429 (CUP).

COLONIES on malt agar white to grey becoming brown to black, floccose to appressed, dark ropy strands of conidiophores frequently present. HYPHAE septate, branched, of two types: hyaline to subhyaline, smooth, 1.5-5 ($\bar{x}$ = 2.8) µm diam, and subhyaline to pale brown, sometimes finely roughened, 2.5-6 ($\bar{x}$ = 3.4) µm diam. CONIDIOPHORES micro nematous to semi-macronematous, mononematous, frequently

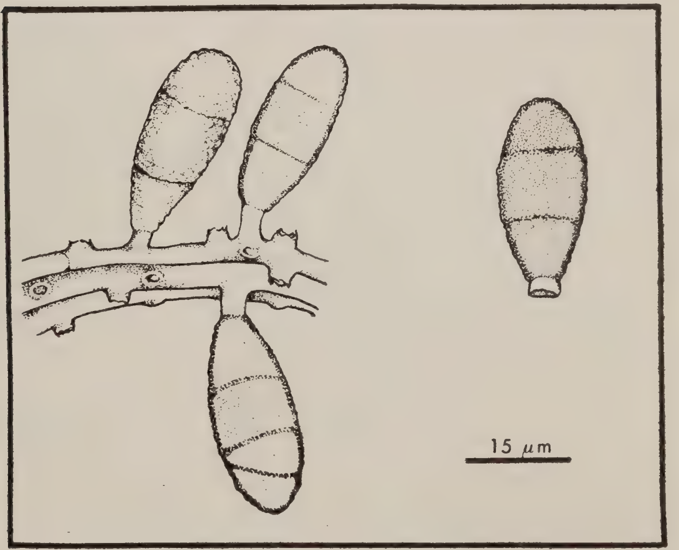


FIG. 1. *Pithomyces funiculosa*. Funiculose conidiophores, conidiogenous cells, and transversely septate conidia with infrequent oblique septa.

funiculose, infrequently branched, septate, subhyaline to pale brown. CONIDIOGENOUS CELLS holoblastic, monoblastic or polyblastic, integrated, intercalary, determinate, cylindric to doliform, denticulate following secession of conidia, denticles short cylindric to doliform, 1-4 ($\bar{x}$ = 2.4) x 1.5-3 ($\bar{x}$ = 2.2) µm. CONIDIA solitary, pleurogenous, mostly verrucose, pale to dark brown, clavate to obovate to obpyriform to broadly or fusiform ellipsoid to reniform, transversely (0-) 1-3 (-4)-septate, mostly 2-septate, may be slightly constricted at the septa, rarely with 1-2 oblique or longitudinal septa, 10-17 ($\bar{x}$ = 13.9) x 6-12 ($\bar{x}$ = 8.5) µm (1-septate), 14-23 ($\bar{x}$ = 18.6) x 7-12 ($\bar{x}$ = 9) µm (2-septate), 17-25 ($\bar{x}$ = 21.2) x 7-12 ($\bar{x}$ = 9) µm (3-septate), bases 2-4 ($\bar{x}$ = 2.6) µm diam, with a portion of the conidiogenous cell usually remaining as a basal frill.

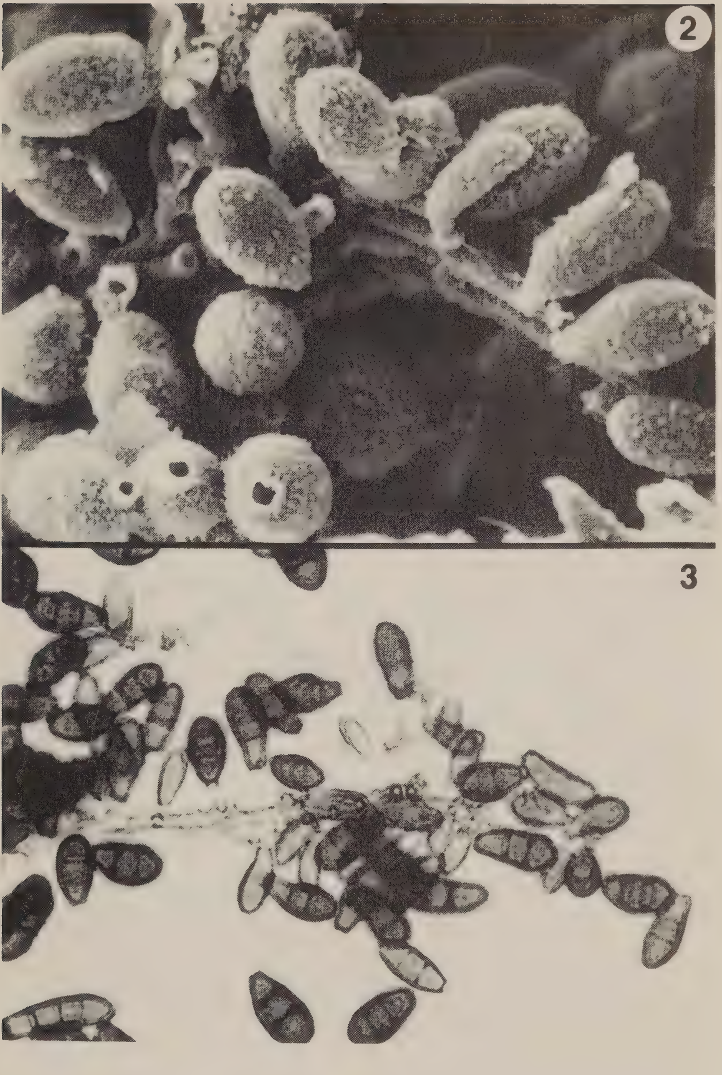
Collections examined: Holotype: Swaziland, Luyengo, Rossman #1429. Dried culture of isolate, from fungal comb in mounds of *Macrotermes ukuzii*. 15 ix 1977 (MPPD). Isotype: Swaziland, Luyengo, Rossman #1429. Dried culture of isolate, from fungal comb in mounds of *Macrotermes ukuzii*. 15 ix 1977 (CUP).

Of the species presently assigned to *Pithomyces*, *P. funiculosa* appears most like *Pithomyces graminicola* Roy & Rai (Ellis, 1976, Roy and Rai, 1968). It differs in its larger, verrucose conidia and the frequently funiculose conidiophores. Examination of the type of *P. graminicola* (IMI 126508) confirmed that *P. funiculosa* is a distinct taxon.

A. Rossman determined that this fungus degrades cellulose using the cellulose-azure method of Smith (1977).

ACKNOWLEDGMENTS

This work was supported in part by a grant from the American Philosophical Society to the third author. Funds provided by the USDA, Forest Service, Forest Products Division (Nos. 12-39 and 12-144) enabled the first two authors to undertake this study. We extend sincere thanks to Drs. J. Leland Crane and G. Morgan-Jones for comments and suggestions regarding the manuscript. Minnesota Agricultural Experiment Station, Scientific Journal Series, Paper No. 10,942.



FIGS. 2-3. *Pithomyces funiculosa*. 2. Scanning electron micrograph illustrating roughened conidia and conidiogenous cells which remain as a basal frill on conidia and as denticles on the often funiculose conidiophores. X1000. 3. Conidia, conidiogenous cells, and funiculose conidiophores from culture on malt agar. X550.

LITERATURE CITED

Ellis, M.B. 1960. Dematiaceous Hyphomycetes. I. Mycol. Pap. 76: 7-19.

Ellis, M.B. 1976. More Dematiaceous Hyphomycetes. Commonwealth Mycological Institute, Kew, England. 507 pp.

Roy, R.Y. and B. Rai. 1968. New species of *Lacellina* and *Pithomyces*. Trans. Brit. Mycol. Soc. 51: 152-155.

Smith, R.E. 1977. Rapid tube test for detecting fungal cellulase production. Appl. and Environ. Microb. 33: 980-981.

MYCOTAXON

Vol. X, No. 1, pp. 251-254 October-December 1979

A NEW SPECIES OF FENNELLOMYCES (MUCORALES)

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SUMMARY

Fennellomyces heterothallicus Misra, Gupta & Lata sp. nov. isolated from dung of rodents and bat is described and illustrated. The species is heterothallic and the zygospores are described in the genus for the first time.

The genus *Fennellomyces* was erected by Benny and Benjamin (1975) to accommodate a single species which was originally described in the genus *Circinella* (Mucoraceae) as *C. linderi* by Hesseltine and Fennell (1955). Because of the simultaneous production of terminal, deliquescent-walled, *Mucor*-like sporangia and circinately borne, apophysate sporangiola having persistent but separable wall, Benny and Benjamin *(loc. cit.)* assigned their genus to the Thamnidiaceae. The type species, *Fennellomyces linderi* (Hesseltine & Fennell) Benny & Benjamin, can be readily distinguished from the other Thamnidiaceae on account of the conspicuous enlargement of the sporophore immediately below the terminal sporangium and also by the tough and membranous sporangiolar wall, the sporangiolar wall of other Thamnidiaceae being fragile but persistent. The zygospores are not known in the type species.

A new species of *Fennellomyces* is described in this communication. It is named *F. heterothallicus* on account of its heterothallic nature. The zygospores are described in the genus for the first time.

Fennellomyces heterothallicus Misra, Gupta & Lata *sp. nov.* FIG. 1

Coloniae in agaro composito ad mucores colendos idoneo crescentes die undecima sub calore 25-27 C ad diametrum 8 cm attingentes, albae, 1.5 cm altae. Sporangiophora ex mycelio per substratum penetrante orta biformia: procera usque ad 1.5 cm alta, 6-21 μ diametro, quaeque gerentia sporangium unum magnum terminale atque circulum unum (vel circula dua) ramorum plerumque verticillatorum lateralium sporangia terminalia singula producentium, ramis eisdem raro ramos secundarios sporangia terminalia producentes gerentibus, ramis omnibus 70-500 μ longis, 5.7-16.0 μ diametro; sub ramis sporangiiferis rami breves circinati per sporangiophororum longitudinem inaequaliter orti sporangiolum unum gignentes vel dua; brevia simplicia vel semel, bis, vel ter modo sympodii ramosa, sporangia nulla, sporangiola tantum in pedicellis circinatis gignentia. Sporangia globosa, 28-58 μ diametro; tunica hyalina, subtiliter echinulata, deliquescens et collare re-

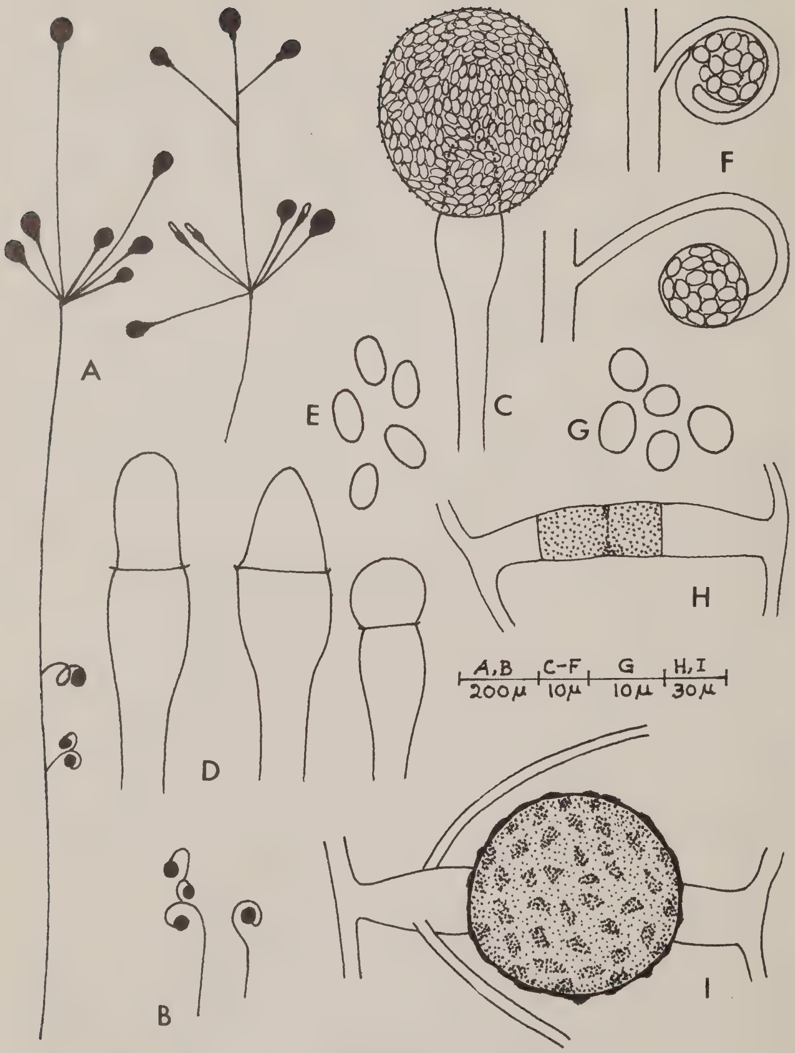
A
B
C
D
E
F
G
H
I
A,B
200μ
C-F
10μ
G
10μ
H,I
30μ

FIG. 1. *Fennellomyces heterothallicus*. A, tall sporangiophores; B, short sporangiophores; C, sporangium; D, columellae and subsporangial vescicles; E, sporangiospores from sporangia; F, sporangiola; G, sporangiospores from sporangiola; H, fusion of gametangia; I, zygospore.

linquens; columellae conicae, elongatae, vel hemisphaericae, leves, nonnumquam palo constrictae, subhyalinae, vel in colorem pallide griseum fuscescentes, 9-44 μ altae, 7-35 μ diametro; dilatatio subsporangialis clavata vel ovoidea, 11-37 μ diametro, pallide grisea vel grisea, infra pallescens. Sporangiola plerumque multispora, globosa vel subglobosa, 15-35 μ diametro, apophyse praedita, dilatatione subsporangiali nulla; tunica incoloris, persistens, pressione fracta; columellae subglobosae vel hemisphaericae, 7-18 μ diametro, leves, incolores. Sporangiosporae e sporangiis ortae ellipsoidales vel oblongae, subhyalinae, leves, tenuiter tunicatae, 5.0-8.2 × 2.3-4.6 μ; e sporangiolis multisporis ample ellipsoidales, ovoideae, vel subglobosae, paulo crassius tunicatae quam eae e sporangiis ortae, 4.6-9.7 × 3.4-5.7 μ. Zygosporae in agara cum extracto malti composito genitae eis in hyphis aereis a conjunctione gametangiorum oppositorum comparium efformatae, globosae vel subglobosae, 38-66 μ diametro, griseobrunneae, tunica crassa verrucosa; suspensores haud pares, 14-40 μ longi, 12-25 μ lati, interdum appendice una (vel plures) longa, 3.4-4.6 μ lata, haud ramosa, continua, e suspensore alio orta praediti. Species heterothallica. Holotypus: PCM *582*.

Colonies on synthetic *Mucor* agar (SMA) 8 cm in diam in 10 days at 25-27 C, dull white, 1.5 cm high; reverse pale straw colored. Sporophores arising directly from the substrate mycelium, erect or ascending, branched, of two types: (1) tall sporangiophores bearing primary sporangia towards the apex and circinately borne sporangiola laterally, (2) short sporangiophores bearing only sporangiola on circinate pedicels. Tall sporangiophores up to 1.5 cm high, 6-21 μ in diam, colorless to very light greyish, smooth or minutely verruculose, each bearing a large, terminal, primary sporangium and one or two groups of usually verticillate, lateral branches also bearing single, terminal, primary sporangia, and these branches, in turn, rarely forming secondary branches bearing terminal sporangia; branches 70-500 μ long, 5.7-16.0 μ in diam; below the sporangia-bearing branches are produced few, short, lateral branches arranged irregularly along the sporangiophore and bearing one or two sporangiola on circinate pedicels. Short sporangiophores colorless to very light greyish, smooth, produced in small numbers, simple or 1-3 times sympodially branched, lacking sporangia and bearing only pedicellate sporangiola; sporangiolar pedicels 2.3-8.0 μ in diam near the middle, circinate or forming a complete circle, rigid, smooth or minutely verruculose, usually slightly darker in color below the sporangiolum. Primary sporangia globose, 28-58 μ in diam, in reflected light white to pale yellow when young, becoming dark grey at maturity; wall hyaline, finely echinulate, deliquescent, leaving a collar; columellae conical, elongate or hemisphaerical, smooth, sometimes slightly constricted near the middle or towards the base, subhyaline to light grey, 9-44 μ high, 7-35 μ in diam; subsporangial swelling clavate to ovoid, 11-37 μ in diam, light grey to grey, the color fading below. Sporangiola mostly multispored, globose to subglobose, white to grey in reflected light, 15-35 μ in diam, apophysate, without subsporangial swelling, wall colorless, persistent, breaking under pressure, leaving a large portion as a collar; columellae small, subglobose to hemisphaerical, 7-18 μ in diam, smooth, colorless. Unispored sporangiola rarely produced, up to 11.5 μ in diam. Sporangiospores from sporangia and sporangiola differing in size and shape; sporangiophores from sporangia ellipsoidal or oblong, rarely slightly curved, subhyaline, smooth, thin-walled, 5.0-8.2 × 2.3-4.6 μ; sporangiospores from multispored sporangiola broadly ellipsoidal, ovoid or subglobose, smooth, slightly thicker-walled than those from sporangia, 4.6-9.7 × 3.4-5.7 μ.

Zygospores formed on mating compatible strains on malt extract agar at 25-30 C, formed on aerial hyphae by fusion of equal gametangia, globose to subglobose, 38-66 μ in diam, greyish-brown, with thick, warted wall; suspensors unequal, smooth, colorless to very light greyish brown, 14-40 μ long, 12-25 μ wide at the point of attachment with zygospores, usually with one or more long, 3.4-4.6 μ wide, unbranched, colorless to very light colored, aseptate appendages arising from one of the suspensors. Heterothallic.

Holotype: PCM *582*, isolated from mouse dung, Jatepur, Gorakhpur, U. P., India, N. N. Gupta, 4 Oct. 1975. A living culture of the type strain has been deposited with Rancho Santa Ana Botanic Garden, Claremont, California.

Other specimens examined: PCM *640*, bat dung, Fatehpur, U. P., India, P. C. Misra, 20 June 1978. PCM *641*, mouse dung, Jatepur, Gorakhpur, U. P., India, N. N. Gupta, 23 June 1978. PCM *642*, shrew dung, Dewan Bazar, Gorakhpur, U. P., India, Kanchan Lata, 28 June 1978.

Zygospores were first observed when the type strain (PCM *582*) was mated with PCM *642* on malt extract agar. Subsequent mating experiments have shown that zygospores are also produced when the type strain is mated with PCM *640* or *641*. Zygospores are not produced on synthetic *Mucor* agar.

Fennellomyces heterothallicus can be easily distinguished from *F. linderi* on the basis of the terminal branching of the tall sporangiophores and the shape of the sporangiophores.

ACKNOWLEDGMENTS

The authors thank Dr. D. P. Rogers for the Latin diagnosis, Dr. R. K. Benjamin for examining a culture of the new species and Dr. M. A. A. Schipper for reviewing the manuscript. The work was supported by grant no. F.23-613/77(SR.II) from the U. G. C., India.

LITERATURE CITED

BENNY, G. L., AND R. K. BENJAMIN. 1975. Observations on Thamnidiaceae (Mucorales). New taxa, new combinations and notes on selected species. Aliso *8:* 301-351.

HESSELTINE, C. W., AND DOROTHY I. FENNELL. 1955. The genus *Circinella*. Mycologia *47:* 193-212.

MYCOTAXON

Vol. X, No. 1, pp. 255-264 October-December 1979

THREE NEW SPECIES OF CLAUSSENOMYCES FROM MACARONESIA

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RÉSUMÉ

Nous présentons la description de trois nouvelles espèces de *Claussenomyces: C. canariensis* de Gran Canarie, et *C. clavatus* et *C. dacrymycetoideus* de Madère. Une autre espèce assignée antérieurement à *Claussenomyces* est transférée à *Chlorociboria* *(C. salviicolor)*. Une clé pour les neuf espèces de *Claussenomyces* connues accompagne ces descriptions.

The genus *Corynella* Boud. was erected for a group of small, highly gelatinous, greenish to blackish inoperculate discomycetes with septate ascospores that produce many asco-conidia both within the ascus and after discharge. The generic name is a later homonym (Korf and Abawi, 1971), and *Claussenomyces* Kirschst. provides an available name for this group of species (Korf, 1973; Dennis, 1978). The type species of Kirschstein's genus, *C. jahnianus* Kirschst., and another transferred from *Holwaya* by Korf and Abawi, release a dark pigment in aqueous KOH mounts (the ionomidotic reaction) while two other species they transferred from *Corynella* do not. This reaction with KOH is an important criterion in the separation of species.

Claussenomyces is clearly allied to *Tympanis* Tode *ex* Fr., recently monographed by Ouellette and Pirozynski (1974). In both genera the excipular and medullary hyphae of the apothecia are embedded in a copious gel, and ascoconidia are produced from the primary ascospores. In *Claussenomyces* the ascoconidia form directly from phialidic cells of the ascospore; in *Tympanis* they arise from one or more intermediate cells budded from the ascospores (Ouellette and Pirozynski, 1974). Primary ascospores in *Tympanis* are rarely more than 2-celled (several-celled in *T. confusa* Nyl.); they are pluriseptate and often muriform in *Claussenomyces*.

Ouellette and Pirozynski (1974) transferred *Tympanis pseudotsugae* Groves, an ionomidotic species with ascoconidia arising directly from primary ascospores, to *Claussenomyces*, and described a new species, *C. luteoviridis* Ouellette & Korf (non-ionomidotic) from Puerto Rico.

One additional species has since been transferred to *Claussenomyces*, a viridous to black, non-ionomidotic species, *Chlorosplenium salviicolor* Ell. & Everh. [as *Claussenomyces salviicolor* (Ell. & Everh.) Korf & Dixon *in* Dixon (1974)]. The junior author has restudied not only the type and isotype specimens of this species, but also the two other collections reported and tentatively so identified by Dixon (1974), one from Dominica (Welden *1876*) on wood, the other from New York (Korf *3231*) on wood of *Carpinus caroliniana*. All three collections show similar apothecial structure: a dark-viridous ectal layer of densely intertwined hyphae in a gel, with some isodiametric cells, some loose hyphal "hairs" on the outside, and a medulla of textura intricata immersed in gel. The New York collection has larger asci and ascospores, and may well represent an undescribed species. Dixon (1974) felt compelled to exclude this species (or these species) from *Chlorociboria* Seaver emend. Dixon because of this medullary gel, which is absent in all the species he classified in that genus (Dixon, 1975). The only genus with similar pigments and gel present in both the ectal and medullary layers appeared to be *Claussenomyces*, which accounts for its transfer.

Chlorosplenium salviicolor differs from any known species of *Claussenomyces* in what we consider to be fundamental features: (i) no ascoconidia are formed, (ii) the ascospores remain unicellular, (iii) the gel is not as copious as in species of *Claussenomyces*, (iv) the structure recalls *Chlorociboria*, not *Claussenomyces*, in transverse sections of apothecia, and (v) there is a distinct green pigmentation of the substrate, just as in typical species of *Chlorociboria*. This (these ?) species can not remain in *Claussenomyces* as we de-

limit the genus. The medullary gel is a character not previously noted in *Chlorociboria,* but the other characters are so close to those of that genus that a formal transfer is made here; another alternative would be the erection of a new genus or of a new subgenus within *Chlorociboria* to accommodate such fungi, which seems premature. The species becomes **Chlorociboria salviicolor** (Ell. & Everh.) Korf, *comb. nov.* (basionym: *Chlorosplenium salviicolor* Ell. & Everh., Proc. Acad. Sci. Philadelphia 45: 146. 1893).

During preparation of a Discomycete Flora of Macaronesia undertaken by the junior author, three apparently undescribed species of *Claussenomyces* were collected and are described here. Two belong in the ionomidotic series *(C. canariensis, C. clavatus),* and one *(C. dacrymycetoideus)* has non-iodomidotic apothecia.

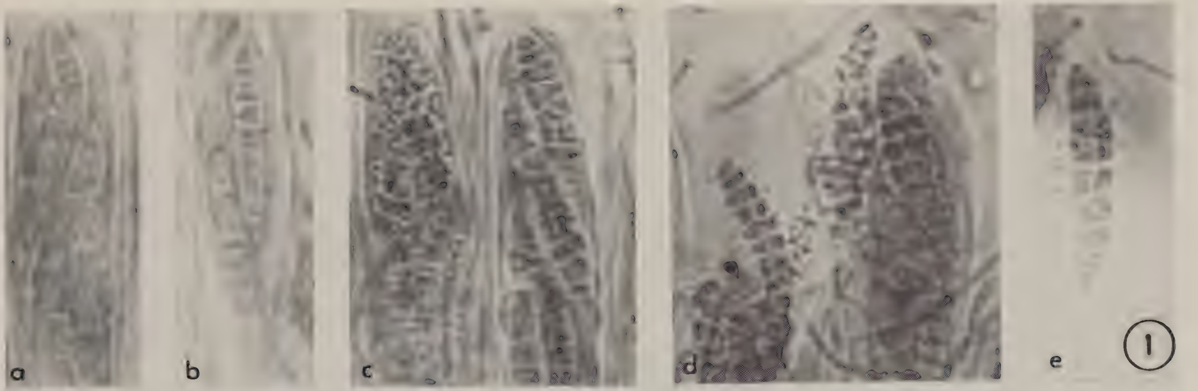
1. **Claussenomyces canariensis** Ouellette & Korf, *sp. nov.*

FIGS. 1, 4

Apotheciis in ligno putrescente superficialibus, fuscis, rugulosis, singularibus, breviter stipitatis, orbicularibus vel ellipticis, (0.25-) 0.3-0.5 (-0.6) mm latis, marginibus fimbriatis; receptaculo nigro, ad maturitatem fere plano; ascis cylindrico-clavatis, 8-ascosporis dein multimicrosporis, (66-) 75-95 (-105) × (7.5-) 9-11 (-14.5) μm; ascosporis hyalinis, denique biseriatis, plerumque fusoideis, pluriseptatis (septis 6-13, cellulis medianis septa verticalia praeterea parientibus), (10-) 16-26 × 3.1-4.6 (-5.0) μm, ascoconidiis ex phialide ipsa difficiliter visibili enascentibus, hyalinis, tenellis, ovoideis, aliquando leniter curvatis; paraphysibus filiformibus, septatis, ramosis, apicibus fuscis, inflatis.

Holotypus: CUP-MM *1025*, on wood, Casas Tamadaba, Pinar de Tamadaba, elev. 1450 m, Gran Canaria, Canary Islands, 21. I.1976, leg. R. P. Korf, W. C. Denison, L. M. Kohn and M. A. Sherwood. (Isotypus: TFC)

Notes: Morphologically, this species is close to *C. luteoviridis,* differing in its ionomidotic reaction and apparent lack of yellowish-green color. The ascoconidia in *C. canariensis* are mostly ovoid, approximately 2.0 × 1.5 μm; they are bacilliform and less than 1 μm broad in *C. luteoviridis*. Phialides and conidia similar to those described for *C. luteoviridis* were observed in one of a few pycnidium-like structures occurring close to the apothecia.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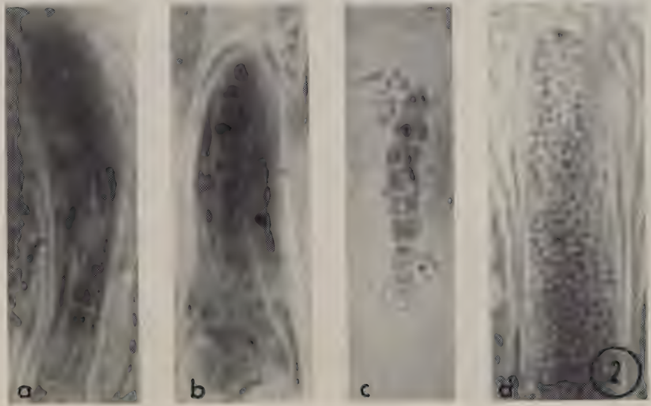
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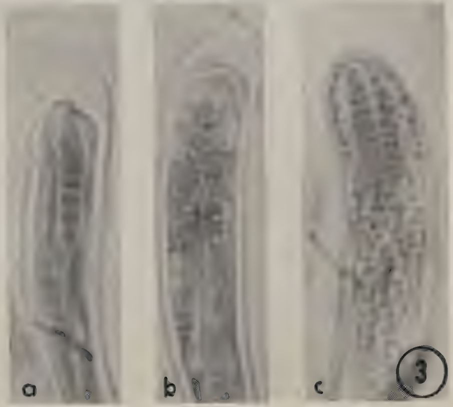
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2. Claussenomyces clavatus Ouellette & Korf, *sp. nov.*

FIGS. 2, 5

Apotheciis in ligno putrescente superficialibus, rubellis, singularibus vel gregariis, 0.3-0.6 mm latis, marginibus irregularibus; ascis cylindrico-clavatis, 8-ascosporis (ascosporis cum aliquando paucioribus, tum majoribus), denique multimicrosporis, 89-96 × 9.0-12.0 μm; ascosporis hyalinis, denique biseriatis, clavatis, pluriseptatis (septis 5-10, cellulis apicalibus medianisque septa verticalia praeterea parientibus), 18.0-25.1 × 3.3-4.6 μm, ascoconidiis ex phialide ipsa difficiliter visibili enascentibus, hyalinis, ovoideis; paraphysibus filiformibus, septatis, ramosis.

Holotypus: CUP-MM *2258*, on decorticated branch, Ribeiro Frio, Madeira, 21.IV.1978, leg. R. P. Korf, L. M. Kohn, N. Korf and A. Y. Rossman.

Notes: In this species the ascospores are distinctly clavate, with the wide or distal part often vertically septate, and the ascoconidia are larger than those of *C. canariensis*. The hymenium has a rugulose appearance with reddish-brown tints. The apothecia give a particularly strong ionomidotic reaction.

3. Claussenomyces dacrymycetoideus Ouellete & Korf, *sp. nov.*

FIGS. 3, 6

Apotheciis in ligno putrescente superficialibus, gelatinosis, olivaceis, singularibus, ca. 0.5 mm latis; ascis cylindricis, 8-ascosporis, dein multimicrosporis, 43-72 × 8.3-

FIGS. 1-3. New species of *Claussenomyces*, × 1250, photomicrographs by the senior author. 1. *C. canariensis*. a, young, fusoid ascospores with a few transverse septa; b, older, more elongate ascospores, with transverse and vertical septa; c, ascus at left filled with ascoconidia nearly obscuring the primary ascospores, ascus at right with muriform ascospores; d, ascospores both within asci and free, producing ascoconidia; e, single, free ascospore producing ascoconidia. 2. *C. clavatus*. a, young, clavate ascospores with one to a few septa and elongated base; b, older, muriform ascospores; c, single, free ascospore producing ascoconidia; d, ascus filled with ascoconidia completely obscuring the primary ascospores. 3. *C. dacrymycetoideus*. a, young, transversely septate ascospores; b, older, very closely septate ascospores; c, ascus with ascoconidia and primary ascospores still visible.

9.9 µm; ascosporis hyalinis, denique biseriatis, cylindricis, pluriseptatis (septis 7-21), 16.0-21.4 × 2.1-2.9 µm, ascoconidiis ex phialide ipsa difficiliter visibili enascentibus, hyalinis, ellipsoideis vel subglobosis; paraphysibus tenellis, filiformibus, anastomosantibus, aliquando scabris.

Holotypus: CUP-MM *2310*, on decorticated branch of *Pinus* sp., at stream just south of Santo da Serra, km mark 18, Madeira, 21.IV.1978, leg. R. P. Korf, L. M. Kohn, N. Korf and A. Y. Rossman.

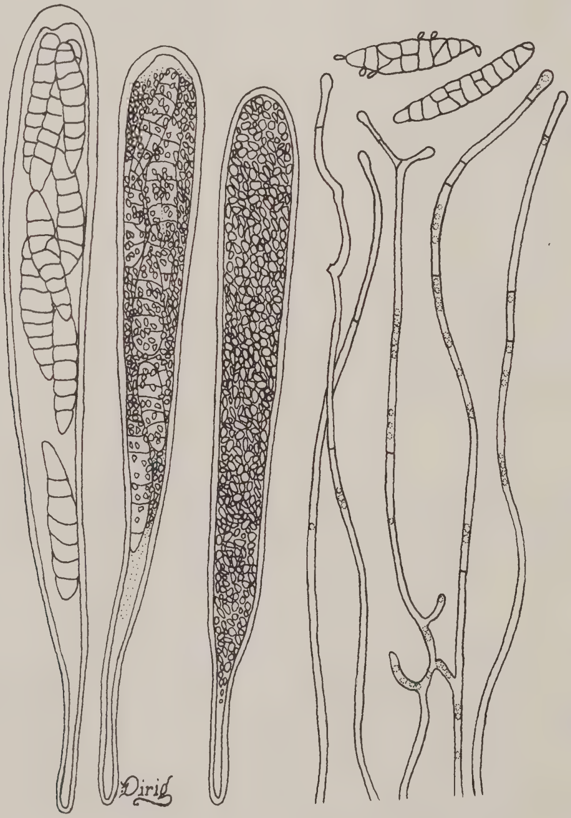

FIG. 4. *Claussenomyces canariensis*, × 1000. Three asci, from left: with mature primary ascospores, primary ascospores partially obscured by ascoconidia, and filled with ascoconidia; paraphyses; primary ascospores, the upper producing ascoconidia. Drawn with the aid of a drawing tube.

Notes: This olive-colored species has at first sight the appearance of a minute *Dacrymyces*. The apothecia are greenish-yellow in 10% KOH. Ascospores are cylindrical and very closely multiseptate (with rare vertical septa) at the time ascoconidia are produced. The ascoconidia are cylindrical to ovoid. The species may be related to *C. atrovirens*, which differs in having larger apothecia and ascospores. The senior author has noted that ascospores of *C. atrovirens* occasionally have one or two swollen, larger cells with vertical septa.

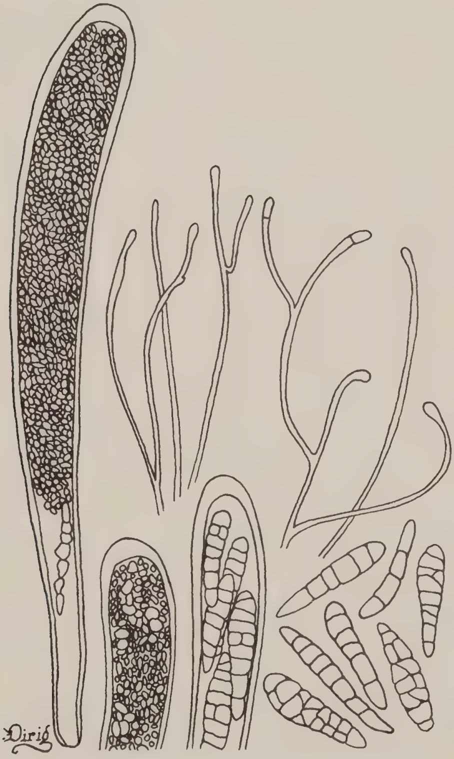

FIG. 5. *Claussenomyces clavatus*, × 1000. Ascus filled with ascoconidia; paraphysis apices; two ascus apices, one with ascoconidia, the other with primary ascospores; 7 primary ascospores. Drawn with the aid of a drawing tube.

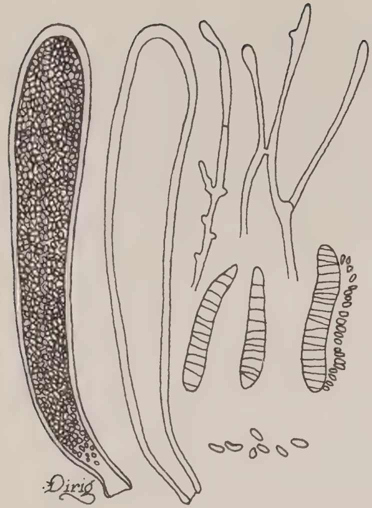

FIG. 6. *Claussenomyces dacrymycetoideus*, × 1000. Two asci, one filled with ascoconidia; paraphysis apices; three primary ascospores, one with a row of ascoconidia along one side; seven ascoconidia. Drawn with the aid of a drawing tube.

Since there is no key to the species of *Claussenomyces* other than that to the four species treated in Korf and Abawi (1971), we present one here:

KEY TO THE SPECIES OF CLAUSSENOMYCES

1. Apothecia nearly black, some with reddish tints, ionomidotic 2
1'. Apothecia light to dark green or yellowish, often finally black, not ionomidotic 6
  2(1). Ascospores cylindrical, transversely 7- to 15-septate 3
  2'(1). Ascospores fusoid or clavate, multiseptate, with apical or medial cells forming vertical septa 4
3(2). Apothecia 2-4 mm diam, ascospores 90-120 (-150) µm long, 7-septate . . . . . *C. jahnianus* Kirschst.
3'(2). Apothecia 0.2-0.3 mm diam, ascospores 38-78 µm long, mostly 15-septate. *C. pusillus* (Rehm) Korf & Abawi
  4(2'). Ascospores distinctly clavate, with apical cells becoming vertically septate; ascoconidia ellipsoidal to subglobose. *C. clavatus* Ouell. & Korf
  4'(2'). Ascospores predominantly fusoid 5
5(4'). Apothecia 1-4 mm diam, asci (175-) 190-240 (-260) µm long, ascoconidia bacilliform. *C. pseudotsugae* (Groves) Ouell. & Piroz.

5'(4'). Apothecia (0.25-) 0.3-0.5 (-0.6) mm diam, asci (66-) 75-95 (-105) µm long; ascoconidia larger, ovoid . . . . *C. canariensis* Ouell. & Korf

6(1'). Ascospores predominantly fusoid, medial part vertically septate; ascoconidia bacilliform.
C. luteoviridis Ouell. & Korf *in* Ouell. & Piroz.

6'(1'). Ascospores predominantly cylindrical, transversely pluriseptate; ascoconidia mostly ellipsoidal to subglobose 7

7(6'). Ascospores 3-septate, (8.8-) 10-13 µm long.
C. prasinulus (Karst.) Korf & Abawi

7'(6'). Ascospores 5-16 (-21)-septate, longer than 15 µm. . 8

8(7'). Apothecia 0.5-1.5 mm diam, brittle, dark green; ascospores 15-30 µm long, 5-11-septate.
C. atrovirens (Pers. *ex* Pers.) Korf & Abawi

8'(7'). Apothecia mostly less than 0.5 mm diam, gelatinous even at maturity, olivaceous; ascospores 16.0-21.4 µm long, 7-16 (-21)-septate. . . . *C. dacrymycetoideus* Ouell. & Korf

ACKNOWLEDGEMENTS

The authors jointly acknowledge the suggestions of Dr. K. A. Pirozynski in reviewing this paper prior to publication. The senior author expresses his thanks to Mr. J. Bard for technical assistance in making measurements. The junior author owes a major debt of gratitude to the National Science Foundation for financial support through NSF grant DEB75-23557 which supported three Discomycete Explorations to the islands of Macaronesia and also provided the funds to support his able technician and illustrator, Mr. Robert Dirig, who has drawn some of the illustrations and inked all of them for this paper, and who prepared many of the microscopic mounts used in these studies. The cooperation of the scientists who accompanied the junior author on the field trips is also deeply appreciated, as is the amiable reception provided to the Expeditions by the staff at TFC, notably that of Prof. Wildpret de la Torre and Prof. Esperanza Beltrán Tejera, and of Dr. David Bramwell, on Gran Canaria, and Dr. G. E. Maul, on Madeira. Their knowledge of the terrain and of the flora made it possible to obtain these collections with much more facility than would otherwise have been possible. Dr. William J. Dress (BH) revised the Latin diagnoses.

LITERATURE CITED

DENNIS, R. W. G. 1978. *British Ascomycetes,* revised edition. J. Cramer, Vaduz. xxvi + 585 pp., 31 figs., 44 col. pl.

DIXON, J. R. 1974. *Chlorosplenium* and its segregates. I. Introduction and the genus *Chlorosplenium.* Mycotaxon *1:* 65-104.

DIXON, J. R. 1975. *Chlorosplenium* and its segregates. II. The genera *Chlorociboria* and *Chlorencoelia.* Mycotaxon *1:* 193-237.

KORF, R. P. 1973. Discomycetes and Tuberales. *In* G. C. Ainsworth, F. K. Sparrow & A. S. Sussman [eds.], *The Fungi: An Advanced Treatise* 4A: 249-319. Academic Press, New York & London.

KORF, R. P. & G. S. ABAWI. 1971. On *Holwaya, Crinula, Claussenomyces,* and *Corynella.* Canad. J. Bot. *49:* 1879-1883, 1 pl.

OUELLETTE, G. B. & K. A. PIROZYNSKI. 1974. Reassessment of *Tympanis* based on types of ascospore germination within asci. Canad. J. Bot. *52:* 1889-1911, 7 pl.

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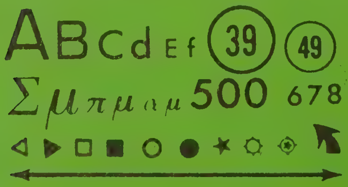

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MYCOTAXON

*AN INTERNATIONAL JOURNAL DESIGNED TO EXPEDITE PUBLICATION
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Volume X   January-March 1980   No. 2

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CONTENTS

Notes on Corticiaceae (Basidiomycetes) VI. *Rogersella eburnea* nov. spec.
KURT HJORTSTAM AND EVEN HØGHOLEN 265
Studies in tropical Corticiaceae (Basidiomycetes) I.
KURT HJORTSTAM AND LEIF RYVARDEN 269
Pocillopycnis, an emendation.......... FRANK DICOSMO 288
A new genus and a new species of Clathraceae.......... BO LIU AND YUN-SUN BAU 293
A new species of *Amanita*.......... DAVID T. JENKINS 296
Notes on Colorado fungi IV: Myxomycetes. D. H. MITCHEL, S. W. CHAPMAN AND M. L. FARR 299
Validation of *Entomophthora aquatica*.... JOHN F. ANDERSON AND SANDRA L. ANAGNOSTAKIS 350
Analysis of the basidium of higher basidiomycetes on the basis of geometrical dependencies.......... S. P. WASSER AND E. G. BERGER 351
Absconditella duplicella and *Cryptodiscus rutilus*: additions to the Ostropalean fungi.......... AMY Y. ROSSMAN 365
Filamentous fungi associated with leaf surfaces of red alder and Douglas fir seedlings in western Oregon.......... AMY Y. ROSSMAN AND K. C. LU 369
Notes on Hyphomycetes.
XXXIII. *Stachybotrys sphaerospora* sp. nov. from South Africa.
G. MORGAN-JONES AND ROBERT C. SINCLAIR 372
XXXIV. Some mycoparasitic species.......... DENNIS J. GRAY AND G. MORGAN-JONES 375
XXXV. *Stenellopsis* gen. nov. .... G. MORGAN-JONES 405
Notes on the genus *Subulicystidium*.......... ANTHONY E. LIBERTA 409
Three new endomycorrhizal *Glomus* spp. associated with actinorrhizal shrubs.
SHARON L. ROSE AND JAMES M. TRAPPE 413
Teratosperma oligocladum, a new hyphomycetous mycoparasite on sclerotia of *Sclerotinia sclerotiorum*, *S. trifoliorum*, and *S. minor*.
F. A. UECKER, W. A. AYERS AND P. B. ADAMS 421
The peniophoroid fungi of the West Indies.... A. PUNUGU, M. T. DUNN AND A. L. WELDEN 428
Two new species of *Cercospora*.......... R. C. RAJAK 455
Mollisia in Macaronesia: an exercise in frustration.
MARK A. GREENLEAF AND RICHARD P. KORF 459
Cytospora vs. *Cytispora*: which is correct? .... LINDA J. SPIELMAN 473
Synopsis of wood-rotting fungi on spruce in North America: III.
K. J. MARTIN AND R. L. GILBERTSON 479
Notices
Second International Congress of Systematic and Evolutionary Biology.......... 502
XIII International Botanical Congress.......... 502
Botanical Latin.......... 502
Revisionary studies in the Hyaloscypheae. I. On genera with "glassy" hairs.
RICHARD P. KORF AND LINDA M. KOHN 503

Author INDEX.......... 513
Reviewers.......... 515
MYCOTAXON publication dates, 9(2) and 10(1).......... 515
INDEX to Fungous and Lichen Taxa.......... 516
Errata, Volumes 9 and 10.......... 524

[MYCOTAXON for October-December 1979 (10: 1-264)
was issued October 19, 1979]

ISSN 0093-4666   MYXNAE 10(2) 265-524 (1980)

Library of Congress Catalogue Card Number 74-7903

*Published quarterly by MYCOTAXON, Ltd., P.O. Box 264, Ithaca NY 14850
For subscription details and availability in microform, see back cover*

MYCOTAXON

Vol. X, No. 2, pp. 265-268 January-March 1980

NOTES ON CORTICIACEAE (BASIDIOMYCETES) VI

Rogersella eburnea nov. spec.

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and

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SUMMARY

A new species, Rogersella eburnea is described and illustrated from material collected in Canada by K. H. Harrison. Additional collections are known from U.S.A. (Tennessee), Norway, and Sweden.

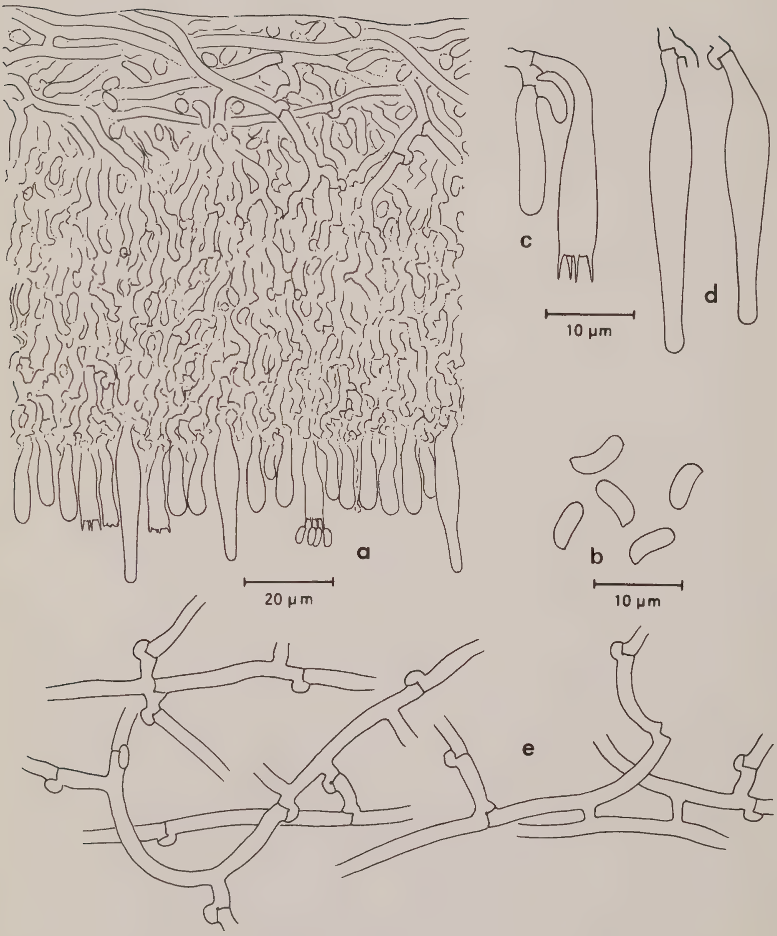
ROGERSELLA EBURNEA Hjortst. & Høgholen nov. spec.

Fructificatio resupinata, effusa, adnata, confluens, membranacea, subceracea, durescens, circiter 100-150 um crassa, incrassata; hymenio leve; colore candido vel eburneo. Systemate hyphali monomitico; hyphis basalibus plus minusve crassitunicatis, facile observatis, rectis vel aliquantum flexuosis, uniformibus, 2.5(3) um latis, fibulatis; hyphis subhymenialibus plus minusve indistinctis, tenuitunicatis, fibulatis. Cystidiis fere ampulliformibus, plerumque capitatis, tenuitunicatis, 30-40 x 5 um. Basidiis terminalibus, subclavatis, constrictis, 20-25 x 5 um, 4- sterigmatibus. Sporis suballantoideis vel reniformibus, 6 x 2.5 um, non amyloideis.

Holotypus: Canada. Ravine, Kentville, N.S., on rotten Tsuga sp. 1934-09-01 K. A. Harrison DAOM 5488.

Isotypus: a portion of the holotype in GB.

Paratypi: Canada. Beren´s River, on Juniperus sp., 1935-08-


c
10 µm
d
a
20 µm
b
10 µm
e

Rogersella eburnea a) section through the fruitbody b) spores c) basidia d) cystidia e) subicular hyphae - Coll. K. A. Harrison 1934.09.01 DAOM 5488. Holotypus. Drawing by John Eriksson.

02 G. R. Bisby DAOM 5804. U.S.A. Tennessee. Great Smokey Mts. Nat. Park. Gatlinburg, Cherokee Orchard, on coniferous wood, L. Ryvarden 14218 O. Ontario, Brant Co, N of Scotland, on conifer, 1937-06-27 R. F. Cain. Norway. Hedmark, Ringsaker, Havik NN87.63, on decidous wood, 1977-10-08 Even Høgholen 770/77 O. Oppland PN 11, Østre Toten, Fugletjern north of Hersjøen, on Picea abies, 1971-08-03 L. Ryvarden 7625 O. Sweden. Västergötland, Hålanda par., NE of the farmstead Grandalen, on coniferous wood, 1970-09-03 K. Hjortstam 3430/b GB.

Fruitbody resupinate, effuse, adnate, confluent, more or less membranaceous, about 100-150 um thick, subceraceous, thickening and becoming firm with age, hymenium smooth, white to ivory white. Hyphal system monomitic. Basal hyphae somewhat thick-walled, generally easily observed, straight or somewhat flexuose, uniform, 2.5(3) um wide. Subhymenial hyphae more indistinct, slightly gelatinized, irregular, thin-walled. All hyphae with clamps. Cystidia rather well differentiated, arising from the subhymenial layer, usually more or less flaskshaped, in most cases capitate, subcapitate or obtuse, thin-walled, 30(-40 x 5 um. Basidia terminal, subclavate, slightly constricted, with walls at first thin then slightly thickened, about 20-25 x 5 um, with 4 sterigmata. Spores suballantoid or reniform (Snell & Dick 1971 pl. 13), rarely ellipsoid, thin-walled, cyanophilous reaction not observed, usually 6 x 2.5 um, not amyloid.

Habitat and distribution. Growing on trunks and branches, preferably of coniferous trees, only once recorded on deciduous wood. Its ecology seems to be quite different from R. sambuci which is more frequent in mixed wood-lands, with predominating deciduous trees, while R. eburnea as far as known, prefer humid coniferous forest, in more or less continental areas.
In aspect of its known distribution the species is widespread in the north temperate region but obviously a rare species.

Remarks. The genus Rogersella was described by Liberta and Navas (1978) and comprises two species, R. asperula, which is the type species and R. sambuci, and is evidently a satellite genus to Hyphoderma. At least R. sambuci has also similarity of some species in Hyphodontia, see Eriksson and Ryvarden (1976 p. 577).

The new species R. eburnea resembles both R. asperula and R. sambuci, preferably in its white fructification and in having the same kind of cystidia, which in most cases are capitate. Furthermore, the hyphal texture and the appearance of the individual hyphae is no doubt very similar. The basal hyphae are for example distinctly observed and slightly thickened, while the subhymenial ones are more or less indistinct and usually slightly conglutinated. The spore-walls are, however, thin-walled in R. eburnea and no cyanophilous reaction is observed. In R. asperula as well as in sambuci the spore-walls may be weakly thickened and

a slight reaction in Cotton blue is usually observed.
To the naked eye the new species reminds very much of Phlebia romellii (Litsch.) Parm. but this species has narrower spores and a dense hyphal texture.

Key to the species of Rogersella.

1 Hymenium farinose, reticulate, verruculose to odontioid, spores asperulate .... R. asperula
1 Hymenium usually completely smooth, seldom tuberculate, spores smooth 2

2 Spores suballantoid to reniform ....R. eburnea
2 Spores ellipsoid, in some collections variable and becoming cylindrical ....R. sambuci

References

Eriksson, J. & Ryvarden, L. 1976: The Corticiaceae of North Europe Vol. IV: 547-886.

Liberta, A. E. & Navas, A. J. 1978: Notes on Venezuelan Corticiaceae (Basidiomycetes). Can. Journ. Bot. Vol. 56: 1777-1781.

Snell, W. H. & Dick, E. A. 1971: A glossary of mycology. 1-181. Harward Univ. Press.

MYCOTAXON

Vol. X, No. 2, pp. 269-287 January-March 1980

STUDIES IN TROPICAL CORTICIACEAE (BASIDIOMYCETES) I

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SUMMARY

The types of 13 tropical Corticiums have been studied and their generic affinities are discussed. The genus Dendrodontia is described based on Grandinia bicolor Talbot. New combinations are proposed in Brevicellicium, Dendrodontia, Hyphoderma, Intextomyces, Mycoaciella, Phlebiopsis, Phlebia, Radulodon and Scytinostromella.

One of us (Ryvarden) has made three excursions in Africa and besides polypores also numerous corticoid fungi were collected. We have now started to study these collections. Many tropical fungi are cosmopolitan in their distribution, and thus it is necessary to consider descriptions from all parts of the world. The results from some type studies are reported here in the first, of what we hope will be a long series of papers concerning tropical corticoid fungi.

BREVICELLICIUM MELLINUM (Bres.) Hjortst. & Ryv. Fig. 1.
nov. comb. Basionym: Corticium mellinum Bres., Ann. mycol. 18: 47, 1920.

Nomenclatural type: Brazil. Rick 434. (S).!

Fruitbody resupinate, effuse, loosely adnate, pellicular to membranaceous (athelioid), cream to ochraceous (probably only with age), subiculum byssoid, paler than the hymenium,

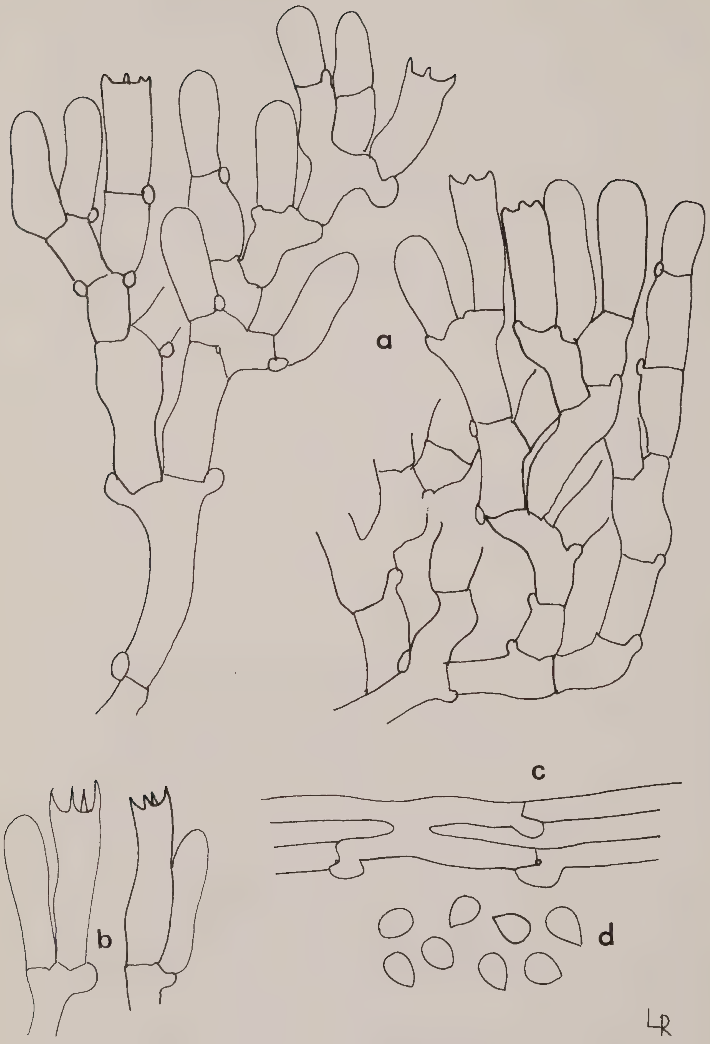

Fig. 1. Brevicellicium mellinum a) sections through the fruitbody b) basidia c) hyphae from the subiculum d) spores. From the type.

margin not determinable.
Hyphal system monomitic. Basal hyphae straight and uniform, anastomosing, thin-walled, 2.5-3(-4) um wide, with clamps. Subhymenial hyphae widened, somewhat isodiametric, 4-6(-8) um wide and with relatively small clamps. *Cystidia* lacking. *Basidia* terminal, clavate to subcylindrical, slightly constricted, with four sterigmata, 15-20 x 4-4.5(-5) um. *Spores* thin or with somewhat thickened walls, in phase-contrast microscope metachroic (red in Cotton-blue) but with walls non or weakly cyanophilous, usually more or less oblique, 3(-4) x 2.5(-3) um, non-amyloid.

Remarks. This may be a somewhat difficult species to recognize as it is rather similar to other species in Corticiaceae e.g. *Leptosporomyces ovoideus* and *Trechispora byssinella* which both are more or less pellicular, non cystidiate, and have narrow and straight basal hyphae and small spores. Chiefly, *B. mellinum* is rather well-marked by the isodiametric subhymenial hyphae and the small oblique spores.

Brevicellicium exile has about the same spore morphology but the spores are larger, in most cases 5-6 x 3.5-4 um. The hymenium is also less pellicular and without distinct subiculum.

Fig. 2.

CORTICIUM SUBOCHRACEUM Bres., Hedwigia 35: 290, 1896.

Nomenclatural type: Brazil, Blumenau. Möller 274. (S).!

Fruitbody resupinate, effuse, adnate, smooth, not separable from the substrate, somewhat membranaceous, ceraceous, in colour light brown, margin indeterminable.

Hyphal system monomitic, Hyphae of the subiculum mostly thick-walled, encrusted and somewhat gelatinized, about 3-4 um wide, with clamps. Subhymenial hyphae similar, but more short-celled, encrusted, the incrustations are especially marked in KOH. *Cystidia* apparently lacking. *Basidia* terminal, clavate, 12-15 x 4-5 um, with four sterigmata. *Spores* ellipsoid to sybcylindrical, thin-walled, smooth, 5-6.5 x 2.5-3 um, non-amyloid.

Remarks. We believe that the species is related to species in *Ceraceomyces* or other related genera, but until additional specimens have been examined we retain it in *Corticium*. At present we have no other suggestions about relationship than in the vicinity of the above-mentioned genus.

CORTICIUM SULPHUROSUM Bres., Ann. mycol. 18: 47, 1920.

Nomenclatural type: Brazil, Bahia. Torrend 59. (S).!

The type specimen is fragmentary and no essential features can be studied. Neither basidia nor spores appear, only hyphae occurring. These are of small demension, encrusted, and apparently without clamps. In macromorphology the species is well distinguished by its sulphury colour and rhizomorphic margin. *Corticium sulphurosum* maybe corresponds with species in *Phanerochaete*.

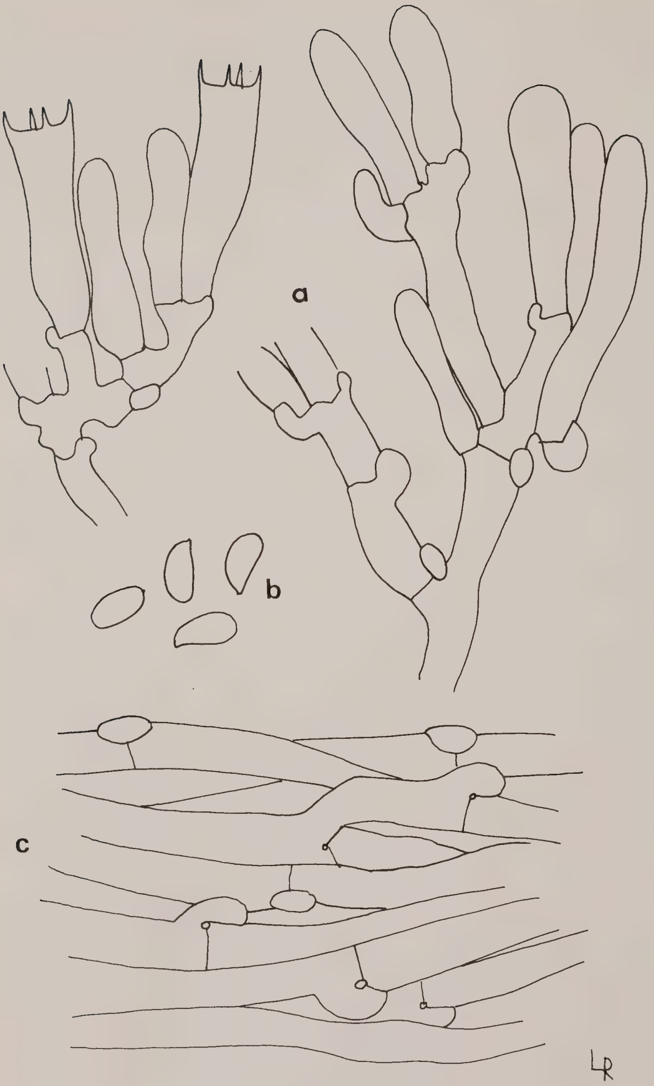

Fig. 2. Corticium subochraceum a) sections through the fruitbody b) spores c) hyphae from the subiculum. From the type.

DENDRODONTIA nov. gen. Hjortst. & Ryv.

Fructificatio resupinata, effusa, laxe adnata, hymenio tuberculato vel odontioideo, cinerascenti; subiculo distincto, infuscato; systemate hyphali dimitico; hyphis skeleticis crassitunicatis, flavidis vel modice brunneis, interdum ramosis, non fibulatis, hyphis subhymenialibus plus minusve hyalinis, tenuitunicatis vel incrassatis, fibulatis,; cystidiis nullis; hymenium dendrohyphidiis numerosis instructum; basidiis clavatis, terminalibus, basibus fibulatis; sporis tenuitunicatis, incoloribus, non amyloideis, in typo plus minusve ellipsoideo vel suballantoideo.

Type species: *Grandinia bicolor* Talbot, in Wakef. & Talbot.

Fruitbody resupinate, effuse, loosely adnate, hymenium tuberculate or odontoid, more or less greyish. Subiculum well-differentiated, brownish.
Hyphal system dimitic. Skeletal hyphae yellowish or light brown, thick-walled, slightly ramificate, without clamps. Subhymenial hyphae more or less hyaline, thin-walled or becoming thickened, with clamps. *Cystidia* lacking. Dendrohyphidia numerous, projecting above the basidia. *Basidia* clavate, terminal, with clamped base. *Spores* thin-walled, in the type specimen ellipsoid to suballantoid, non-amyloid.

Remarks. The main features of this genus are the dimitic hyphal system, with ramified brownish skeletal hyphae and the occurrence of hyaline dendrohyphidia. The fruitbody is in vertical section well-marked by a brownish basal zone below the subhymenium. The spores are thin-walled and non-amyloid as well as the hyphae. We are of the opinion that these characters should justify a new genus.

Dendrodontia is related to *Scytinostroma*, but rather well distinguished by the non-dextrinoid skeletal hyphae. The skeletal hyphae in *Dendrodontia* are brown, and no noticeable change in colour is seen in Melzer's reagent. The dendrohyphidia could remind one of those in *Laeticorticium* but species of that genus have usually basidia with basal bladder and all known species are also monomitic, and the hyphae are hyaline.

Fig. 3.

DENDRODONTIA BICOLOR (Talbot) Hjortst. & Ryv. nov. comb.

Basionym: *Grandinia bicolor* Talbot in Wakef. & Talbot, Bothalia IV: 947, 1948. (Type specimen: W. R. Rump 100, 27756, South Africa, Town Bush, Pietermaritzburg).

Fruitbody resupinate, effuse, loosely adnate, somewhat tough, orbicular to confluent, with the hymenium tuberculate or slightly odontioid, subiculum brownish and well--differentiated, margin distinct, consisting of brown subicular hyphae.
Hyphal system dimitic. Skeletal hyphae brownish, thick--walled, slightly branched, non-fibulate, about 3 um wide. Subhymenial hyphae hyaline, thin-walled and easily separa-

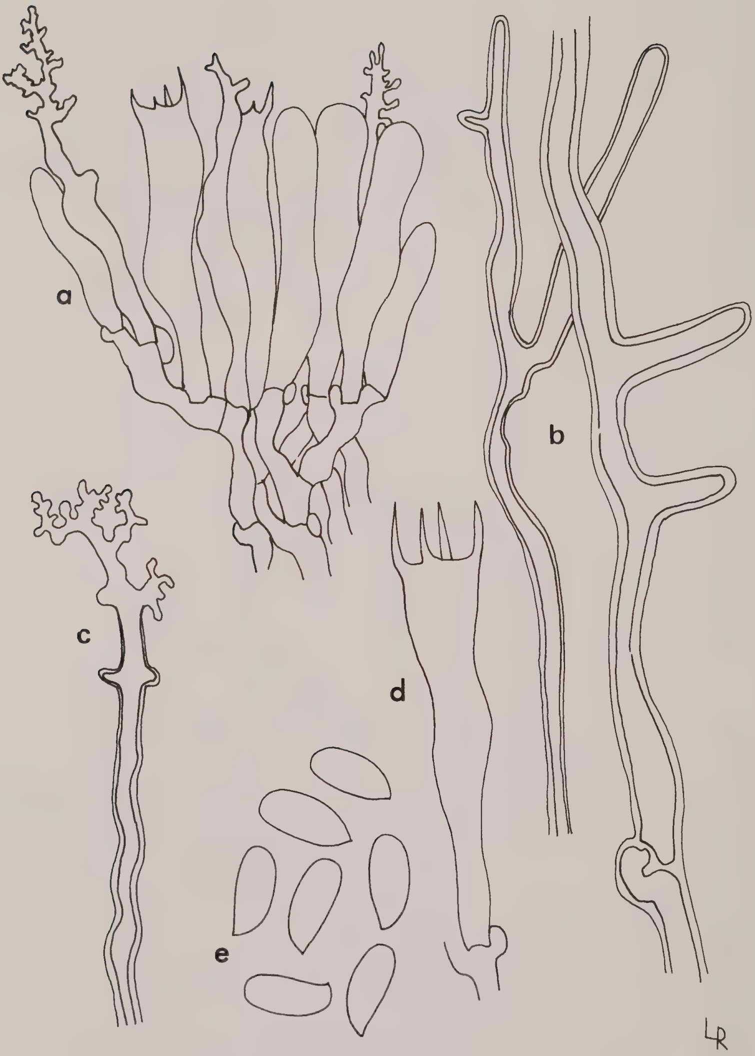

Fig. 3. *Dendrodontia bicolor* a) section through the fruitbody b) skeletal hyphae c) dendrohyphidium d) basidium e) spores. Coll. Ryvarden 10182(O).

ted from the skeletal ones, with clamps. Cystidia lacking but with dendrohyphidia between the basidia, arising from the subhymenial hyphae, thin-walled, non-dextrinoid and non-amyloid. Basidia clavate, somewhat constricted, 30-35 x 6-7 um, with four sterigmata. Spores ellipsoid to subcylindrical, thin-walled, usually 8-10 x 3.5-4 um, non-amyloid.

Remarks. Easily recognized species because of its brown skeletal hyphae and distinct margin with the hymenium tuberculate or odontioid. Also well delimited from other dimitic species through its hyaline, thin-walled dendrohyphidia and rather large, more or less ellipsoid spores which are non-amyloid.

Specimens studied: Africa, from the type locality Rump 217 (K). Tanzania. Kilimanjaro Prov. Mt. Kilimanjaro W slope, W Kilimanjaro Forest Sta. alt. c. 1800 m. 1973-02-10/11 Ryvarden 10182.

HYDNUM EICHELBAUMII P. Henn.

Englers bot. Jahrb. Vol. 38: 108, 1907.

Nomenclatural type: Africa, Ost-Usambara, Aman. Sept. 1903, F. Eichelbaum No. 40. (S).!

The type specimen consists of a small fragment and cannot be adequately described. It is probably closely related to genera in Coniophoraceae.

Fruitbody resupinate, effuse, adnate, hydnoid and few aculei present in the collection, margin not determinable, rhizomorphs absent, aculei subulate, brownish, 0.5-1 mm long with smooth hymenium between the aculei, subiculum whitish, easily distinguished.
Hyphal system monomitic, individual hyphae thin-walled, smooth, non-amyloid and non-dextrinoid, more or less collapsed, clamps not observed. Cystidia or gloeocystidia thin-walled, obtuse, smooth, about 50-80 x 5-7 um. Basidia mostly collapsed. Spores brownish, with germpore, thick-walled, smooth, broadly ellipsoid or subglobose, 7-9 x 5 um, non-amyid.

Fig. 4.

HYPHODERMA RUDE (Bres.) Hjortst. & Ryv. nov. comb.

Basionym: Odontia rudis Bres., Ann. Mycol. Vol.: 18: 42, 1920.

Nomenclatural type: Brazil, S. Leopoldo. Rick 51. (S).!

Additional specimen seen: Brazil, S. Leopoldo. Theissen (S).

Fruitbody resupinate, effuse, adnate, hymenium distinctly odontioid, with small slightly fimbriate, conical aculei, usually less than 0.5 mm long, creamish, margin not determinable in type specimen.
Hyphal system monomitic. Basal hyphae thick-walled, smooth, ramified, long-celled. Subhymenial hyphae more thin-walled,

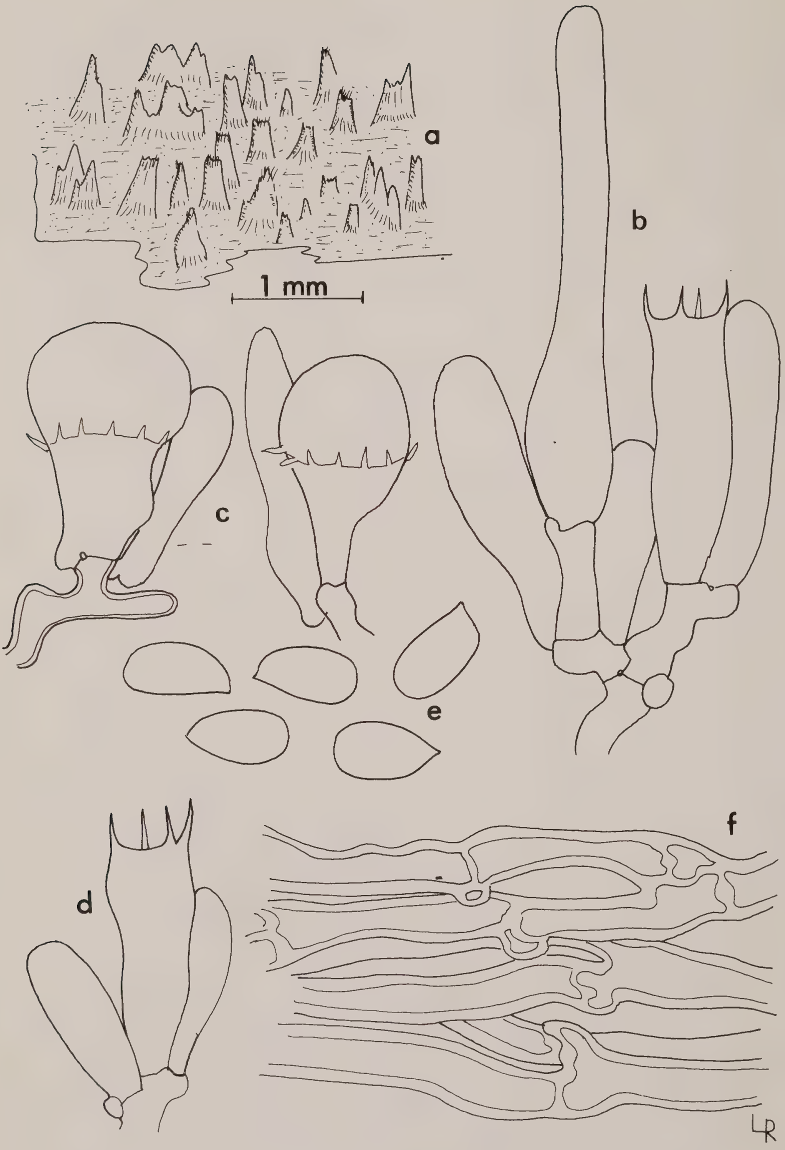

Fig. 4. Hyphoderma rude a) part of fruitbody b) cystidium and basidia c) stephanocysts d) basidium e) spores f) hyphae from the subiculum. From the type.

with shorter cells. All hyphae with clamps and about 3-4 um wide, non-amyloid or dextrinoid. Cystidia of two kinds: 1) tubular gloeocystidia, terminal, obtuse, mostly enclosed in the texture and somewhat difficult to find, about 40-70 x 8-12 um, 2) stephanocystidia, numerous and easily observed, globose and in the middle with a dentated collar, clamped at the base, about 15 x 10 um. Basidia terminal, more or less clavate, slightly constricted, with four sterigmata, 25-30 x 5-6 um. Spores thin-walled, smooth, ellipsoid, with oil-droplets in the protoplasm, usually 9-10 x 6 um, non-amyloid.

Remarks. The species is well recognized by occurrence of stephanocysts and having a odontioid hymenium. It belongs in vicinity of Hyphoderma praetermissum (Karst.) Erikss. & Strid.

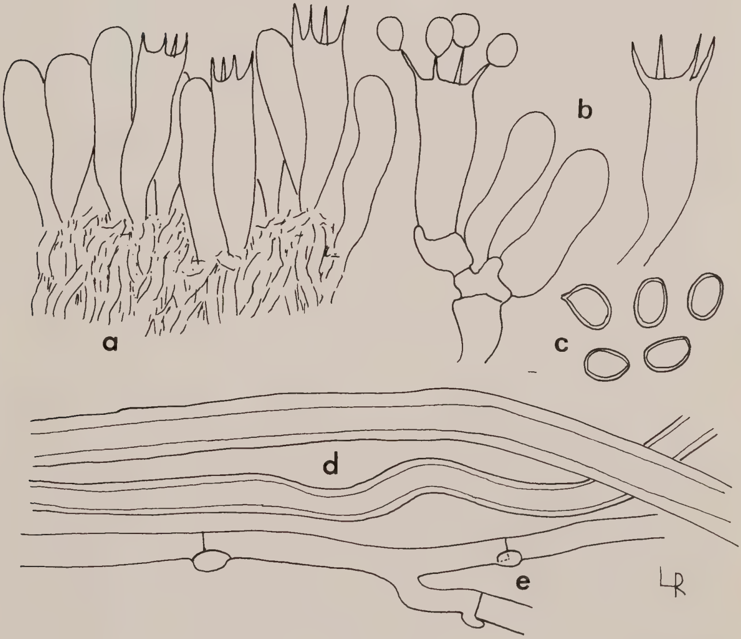

Fig. 5. Intextomyces umbrinus a) section through the fruitbody b) basidia c) spores d) skeletal hyphae e) generative hyphae. From the type.

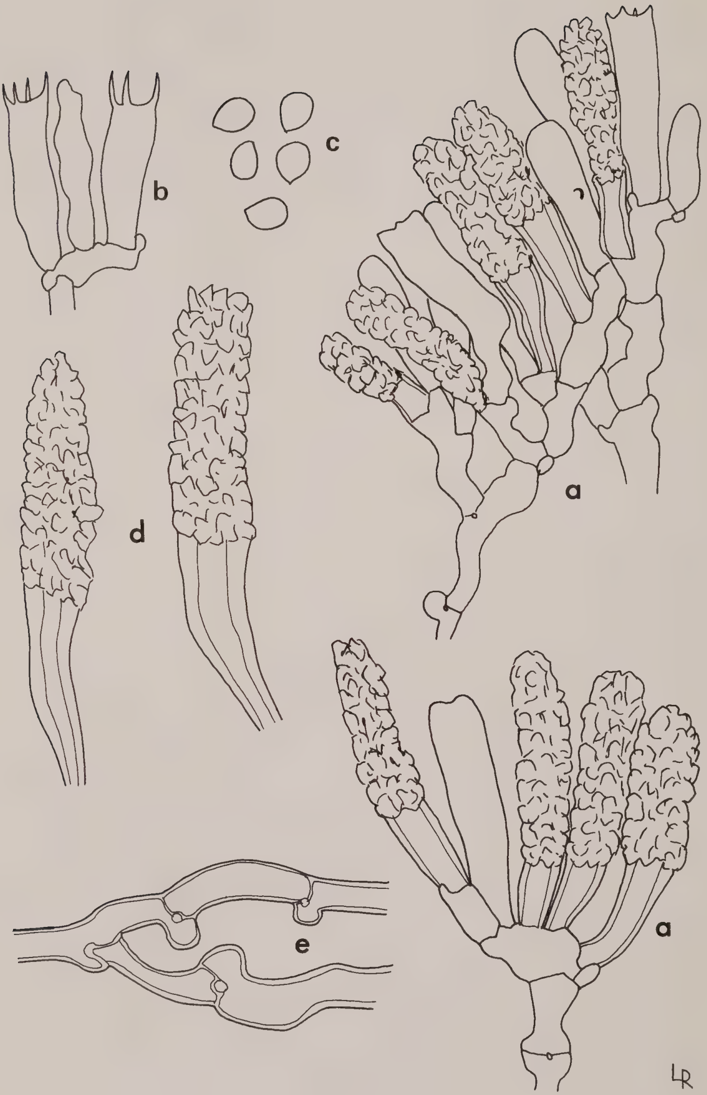

Fig. 6. Kneiffia brasiliensis a) section through the fruitbody b) basidia c) spores d) cystidia e) hyphae. Coll. Brazil, Bahia, Torrend 1912(S).

Hyphoderma odontiaeforme Boid. & Berth. which has been described from Africa (Berthel & Boidin 1966) is probably the same but no authentic material has been studied by us of that species. The description and the figûre corrrespond with H. rude.

Fig. 5.
INTEXTOMYCES UMBRINUS (Bres.) Hjortst. & Ryv. nov. comb.

Basionym: Radulum umbrinum Bres., Hedwigia 35: 287, 1896.

Nomenclatural type: Brazil, Blumenau. Möller 262.(S).!

Fruitbody resupinate, effuse, adnate, hymenium hydnoid with scattered aculei, ceraceous, light brown.
Hyphal system apparently dimitic or subdimitic. Hyphae of three types 1) basal hyphae thick-walled and simple septate, but some with clamped septa, hyaline and about 4-5 um wide, mostly straight and uniform. 2) Some broad hyphae observed, mostly in the subiculum, up to 7 um wide, usually with clamps. 3) Subhymnenial hyphae thin-walled and with clamps, 3.5-4 um wide. Cystidia lacking. Basidia terminal, more or less cylindrical or clavate, no clamps seen at the base, but as in I. contiguus the bearing hyphae with clamps, 20-30 x 5-6 um, with 4 sterigmata. Spores subglobose or rarely globose, smooth, thick-walled and strongly cyanophilous, 3.5-4 x 3-3.5 um or 3.5-3 um across, non-amyloid.

Remarks. The species is easily recognized by its odontioid appearance and in having small, thick-walled spores. It is questionable whether this species belongs to Intextomyces, and additional material is needed for further studies. However, we have incorporated the species in this genus because of its basidial similarities to I. contiguus.
We have not been able to exactly confirm the occurrence of clamps at all septa because most of the hyphae are conglutinated and difficult to separate. Besides, as in many old collections of fungi, the hyphae are shrunk and difficult to study.

KNEIFFIA BRASILIENSIS Berk., Fungi Brasiliensis, Vidensk. Meddel. Naturhist. Fören. Kjöbenhavn, p. 31, 1879. Fig. 6.

Material studied: Brazil, Bahia. 19(12) Torrend. ex herb. Bresadola, det. Bres., typica! (S).!

Fruitbody resupinate, effuse, adnate; hymenium somewhat ochraceous, destinctly odontioid, aculei usually more or less conical, seldom flattened, slightly fimbriate, margin similar, thinning out.
Hyphal system monomitic. Basal hyphae with walls thin to thickened, smooth, slightly gelatinized, about 2-3 um wide, subhymenial hyphae similar, usually thin-walled. All hyphae with clamps, easily observed. Cystidia numerous, terminal, strongly encrusted, (metuloids), conical, 30-40 x 8-10 um. Basidia terminal, clavate, generally 15 x 4-4.5 um, with four sterigmata. Spores subglobose, thin-walled, smooth, 4 x 2-2.5 um, non-amyloid.

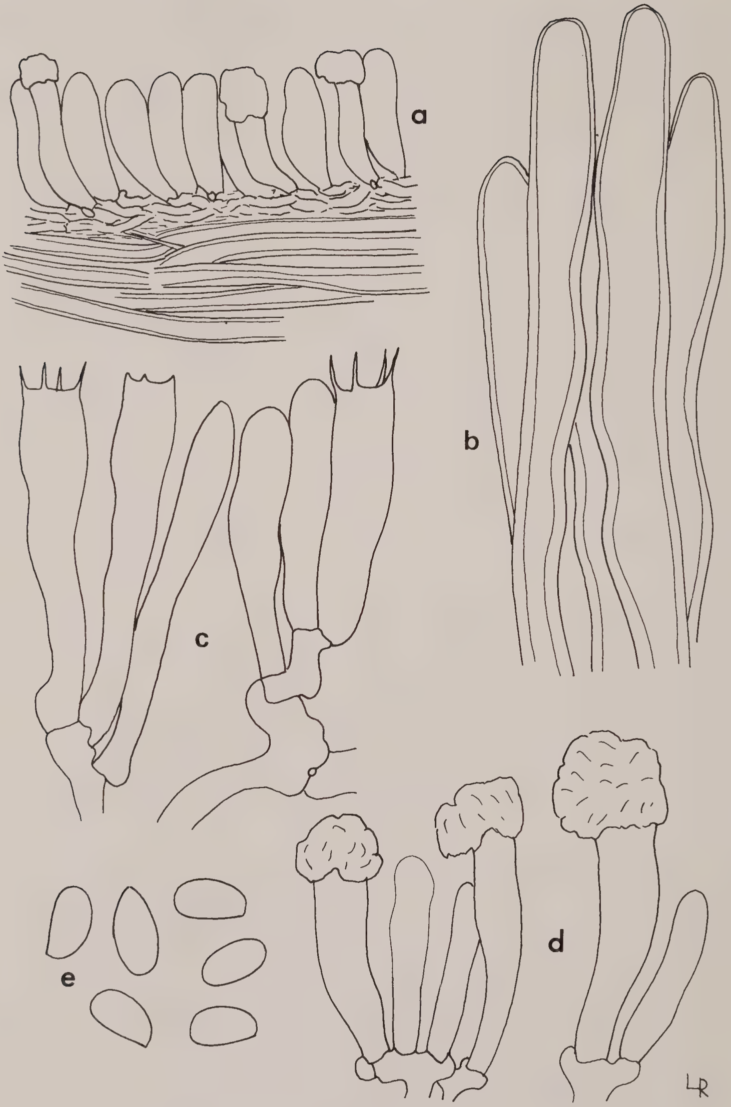

Fig. 7. Mycoaciella hinnulea a) section through the hymenium b) skeletal hyphae c) basidia d) cystidia e) spores. From the type.

Remarks. This species is quite similar to Phlebia queletii (Bourd. & Galz.) M. P. Christ. and the only distinguishing character seems to be the spores which are larger in P. queletii (about 5 x 3 um). We have not seen any authentic material and therefore we do not propose a new combination. If Bresadola's concept is correct, the species belongs in Phlebia sens. lat.

Fig. 7.

MYCOACIELLA HINNULEA (Bres.) Hjortst. & Ryv. nov. comb.

Basionym: Odontia hinnulea Bres., Ann. mycol. Vol. 18: 42, 1920.

Nomenclatural type: Brazil, S. Leopoldo. Rick 15. (S).!

Additional specimen: Brazil, S. Leopoldo, ad lignum frondosum. Rick 20 (S)

Fruitbody resupinate, effuse, adnate, ceraceous, hymenium distinctly odontioid to hydnoid with large, subulate aculei, about 1.5-2 mm long, light to reddish brown, subiculum rather thin but easily distinguished.
Hyphal system dimitic. Skeletal hyphae present in central part of the aculei, thick-walled, in some cases slightly encrusted with small granules, intertwined, without clamps, but with several adventitious septa, about (2.5)-3.5-5 um wide, non dextrinoid and non-amyloid. Generative hyphae thin-walled, generally smooth, with clamps, 2.5-3 um wide. Cystidia clavate and covered with a resinous, yellowish globule up to 20 um long. They are easily observed because its light-refractivity in phase-contrast microscope. Basidia terminal, more or less clavate, with four sterigmata, ca. 20 x 4-5 um. Spores thin-walled, smooth, ellipsoid, variable in size but generally 6-7 x 3.5 um, non amyloid.

Remarks. Easily recognized species by its dimitic hyphal system and cystidia. It is closely related to M. bispora (Stalpers) Erikss. & Ryv. but may be separated by larger spores, which measure 4-5.5 x 2.5-3 um in M. bispora. M. hinnulea clearly belongs in Mycoaciella and in several respects is distinguishable from e.g. Mycoacia by its dimitic hyphal system and from Steccherinum in lacking the large encrusted cystidia arising from skeletal hyphae.

PHLEBIA ROSEA (P. Henn.) Hjortst. & Ryv. nov. comb. Fig. 8.

Basionym: Grandinia rosea P. Henn. Vergl. Eng. Bot. Jahrb. Vol. 38: 108, 1907.

Nomenclatural type: Tanzania: Ost-Usambara, Eichelbaum, no 72C. Aug. 1903 (S!).

Additional specimens seen: Tanzania, Arusha prov. Arusha nat. park. Lake Kusare, 1500 m. 9 Feb. 1973. Ryvarden 9912 (O). Kenya. Eastern Prov. Aberdare Mountains, Kimakia Forest sta. 2200 m. 16 January 1973. Ryvarden 8951 (O).

Fruitbody resupinate, effuse, adnate, about 0.5 mm, distinctly grandinioid with small aculei, more or less ceraceous, rosy-pinkish, with age more or less membranaceous and somewhat dull, margin similar or slightly fibrillose. Hyphal system monomitic. Basal hyphae thin-walled, straight and uniform, 5 um wide, sometimes encrusted, subhymenial hyphae narrower and about 2.5-3 um wide, all hyphae without clamps. Cystidia lacking. Basidia narrowly clavate to tubular, 25-30 x 5 um, with four sterigmata. Spores ellipsoid or subglobose, smooth, 4-5 x 3 um, with distinct apiculus, non-amyloid.

Remarks. The rosy colour and the grandinioid, more or less ceraceous fruitbody together with non-clamped hyphae are the striking characters of this species. The fungus seems to be easily recognized in the genus Phlebia sens. lat.

Additional specimen studied: Africa, Kenya, Eastern prov., Aberdare Mounts. Kimakia Forest sta., alt. c. 2200-2400 m. 1973-01-16/18. Ryvarden 8951 (O).

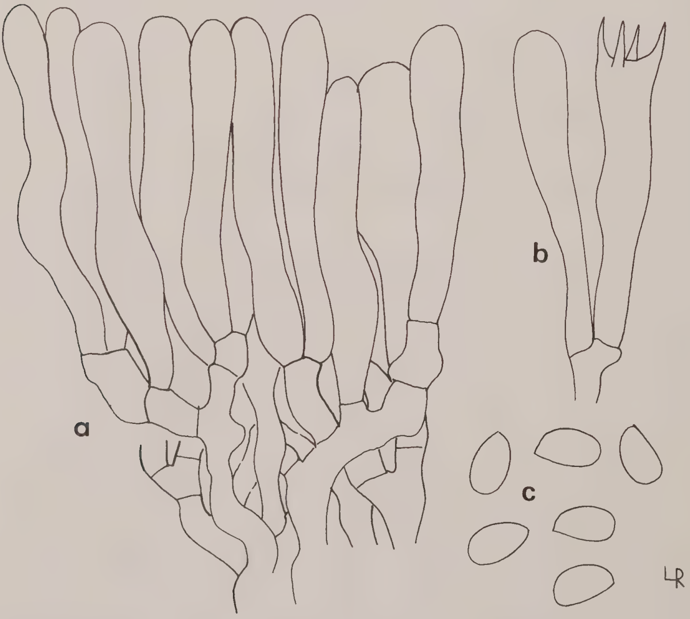

Fig. 8. Phlebia rosea a) section through the hymenium b) basidium c) spores. Coll. Ryvarden 8951(O).

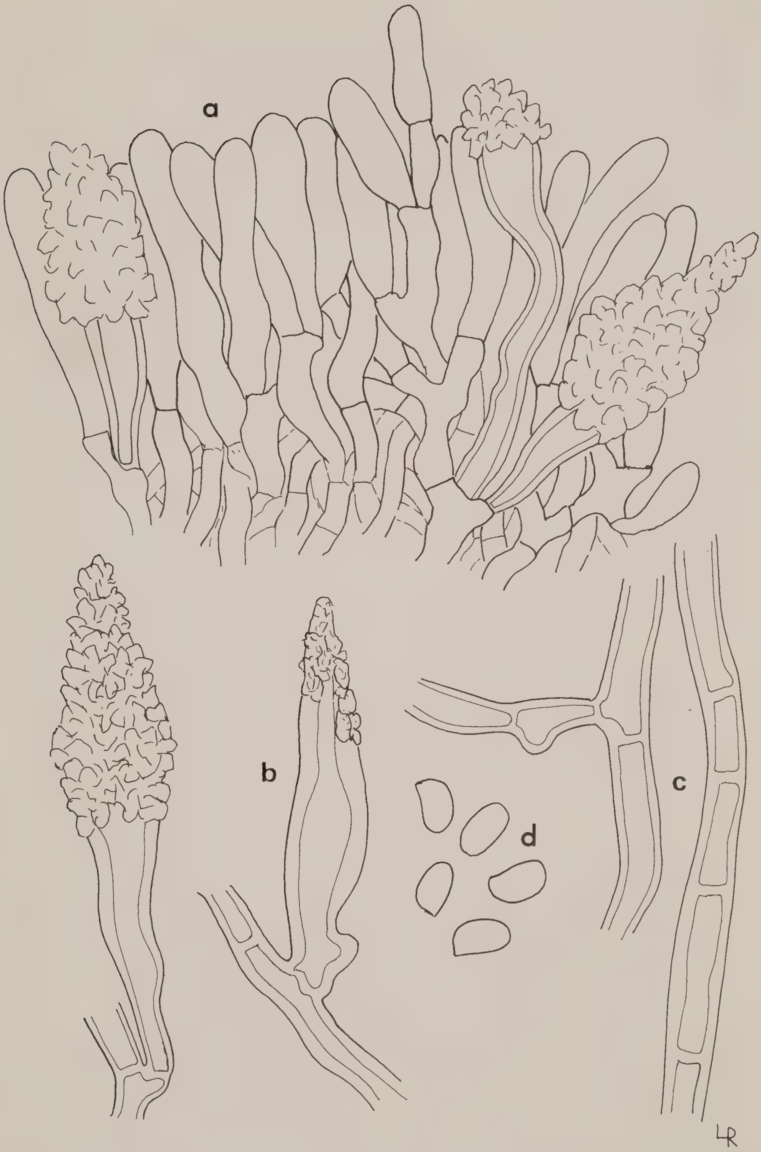

Fig. 9. Phlebiopsis galochroa a) section through the hymenium b) cystidia c) hyphae d) spores. From the type.

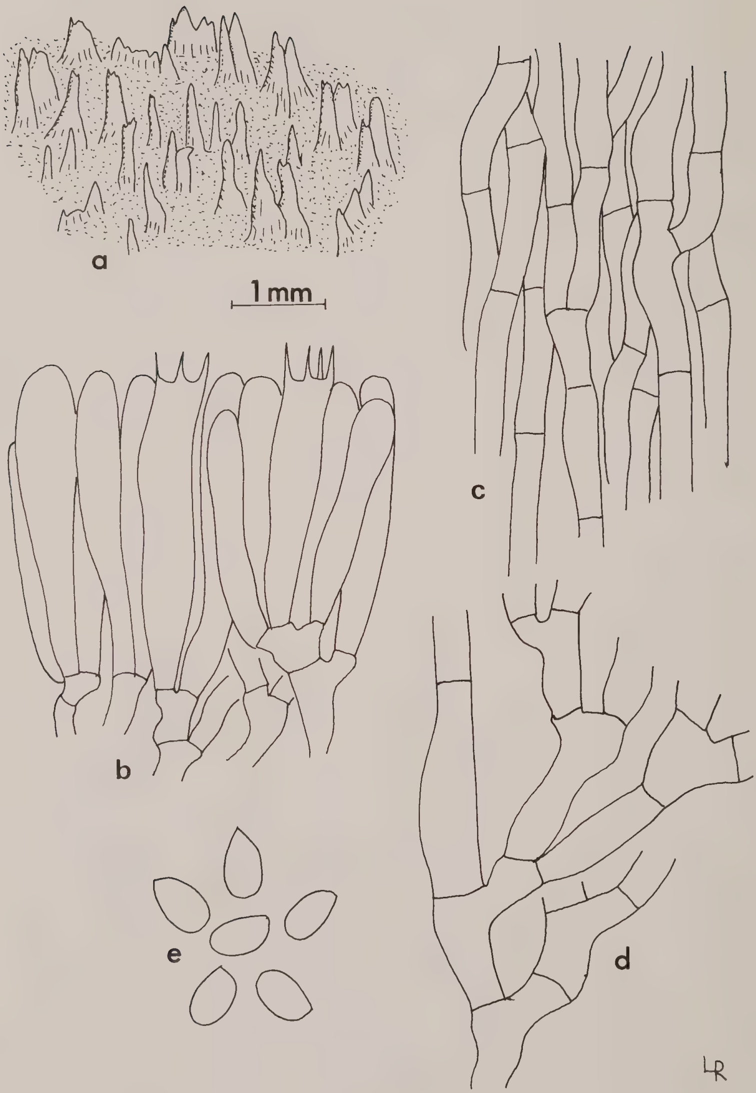

Fig. 10. Radulodon subquercinus a) part of fruitbody b) section through the fruitbody c) hyphae from the core of the teeth d) hyphae from the subiculum e) spores. From the type.

Fig. 9.

PHLEBIOPSIS GALOCHROA (Bres.) Hjortst. & Ryv. nov. comb.

Basionym: *Peniophora galochroa* Bres. Hedwigia 35: 290, 1896.

Nomenclatural type: Brazil, Blumenau. Möller s.n. (S).!

Fruitbody resupinate, effuse, adnate, hymenium smooth, under a lens (50 x) with indistinctly projecting cystidia, light ochraceous, subiculum creamish and and easily observed, tough, consisting of thick-walled, less branched hyphae, margin not especially differentiated.
Hyphal system monomitic or subdimitic (?). Hyphae of the subiculum thick-walled, in KOH and Melzer's reagent light-refracting, in Cotton blue with the walls easily distingguishable but not cyanophilous. The hyphae are in most cases smooth but slightly encrusted ones occur, about 3-3.5 um wide, not amyloid or dextrinoid. Subhymenial hyphae branched, less light-refracting, usually thin-walled or thickened, all hyphae without clamps. *Cystidia* more or less imbedded, only few projecting above the basidia, terminal, thick-walled and strongly encrusted (Metuloids), 50-60 x 7-10 um. *Basidia* terminal, clavate or subcylindrical, 15-20 x 3.5-4.5 um, with four sterigmata. *Spores* thin-walled, ellipsoid, usually 5-6 x 4 um, non-amyloid or dextrinoid.

Additional specimen: Brazil, S. Catharina, Blumenau. Möller s.n.

Recently Jülich (1978) described the genus *Phlebiopsis* with *P. gigantea* as type species. *Peniophora galochroa* lacks the dense resinous zone so prominent between the subiculum and the subhymenium in *P. gigantea*, besides the cystidia are smaller and the texture softer in general. However, as the hyphae, spores and basidia are very similar in the two species we felt it natural that they were placed in the same genus.

Fig. 10.

RADULODON SUBQUERCINUS (P. Henn.) Hjortst. & Ryv. nov. comb.

Basionym: *Radulum subquercinum* P. Henn. Monsunia I, Fungi II, p. 46 (in reprint) 1899.

Nomenclatural type: Java, Salek. 1897-09-11 leg. E. Nyman (S).!

Fruitbody resupinate, adnate, ochraceous, margin not determinable, hymenium odontioid to hydnoid, hard and somewhat brittle, aculei conical, smooth, rather large, about 0.5-1 mm long.
Hyphal system monomitic. Basal hyphae thin-walled, smooth, some arranged in a parallel manner, slightly conglutinated, some irregular, 3-5 um wide, without clamps but a few clamps have been observed on hyphae next to the substrate. Subhymenial hyphae similar in width, irregular, no clamps

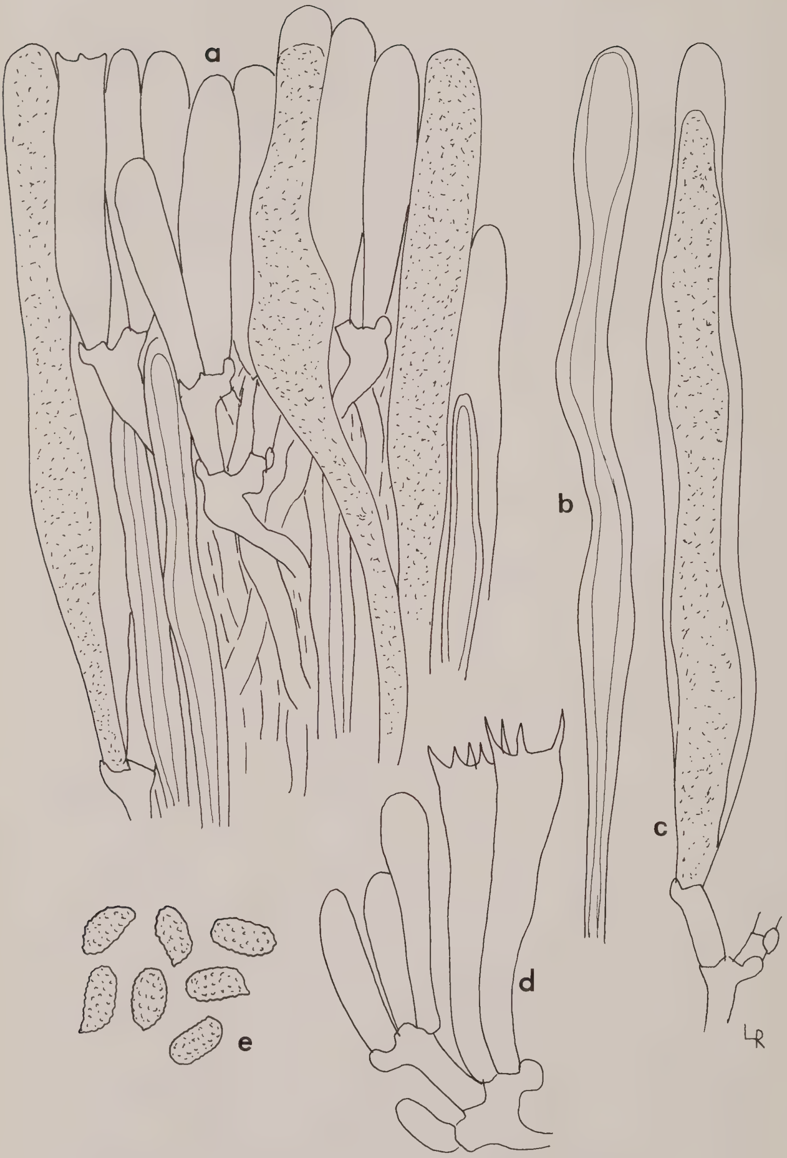

Fig. 11. Scytinostromella cerina a) section through the hymenium b) skeletal hyphae c) gloeocystidium d) basidia e) spores. From the type.

observed. Cystidia not seen. Basidia terminal, clavate, 20-30 x 4.5(6) um, with four sterigmata. Spores ellipsoid or subglobose, thin-walled, smooth, 4.5-5(-6) x 3-3.5(-4) um, non-amyloid.

Remarks. The species seems to be related to the other species in Radulodon by its hydnoid, hard and brittle fruitbody. R. subquercinus differs from other species in Radulodon in its spore morphology. Known species in the genus have spores which are nearly globose and also with somewhat thickened walls, while spores of R. subquercinus remind one of those of Phanerochaete. As for many other species of Corticiaceae we are of the opinion that additional materials are needed to confirm the relationship.

Fig. 11.

SCYTINOSTROMELLA CERINA (Bres.) Hjortst. & Ryv. nov. comb.

Basionym: Corticium cerinum Bres. Ann. mycol. 18: 47, 1920.

Nomenclatural type: Brazil, ad corticem arborum. Torrend 302. (S).!

Fruitbody resupinate, effuse, adnate, soft membranaceous, light yellowish to brownish, hymenium smooth, margin not especially differentiated or becoming slightly fibrillose. Hyphal system dimitic. Skeletal hyphae thick-walled, straight and uniform, not or rarely ramified, indistinctly pigmented, 2-2.5 um wide, without clamps, non-dextrinoid but the walls apparently with weak cyanophilous reaction, generative hyphae ramified, thin-walled, 2.5-3.5(-4) um wide, with clamps. Gloeocystidia present, mostly cylindrical or tubular, terminal, sometimes widened at the apex, in KOH with light-refracting contents, no aldehyde reaction, generally 90-120 x 10 um. Basidia terminal, somewhat extended clavate, normally with four sterigmata, in some cases two-sterigmated basidia observed, about 40-50(60) x 5 um. Spores thick-walled, ornamented (easily observed in Melzer's reagent), ellipsoid, 4.5-5 x 2.75-3 um, distinctly amyloid.

Remarks. Easily recognized species owing to its gloeocystidia and dimitic hyphal system. The location to the genus Scytinostromella seems to be well established. For further information of this genus see Freeman and Petersen (1979). Scytinostromella humifaciens (Burt.) Freem. & Pet. seems to come close to S. cerina but has subulate and shorter cystidia, besides smaller spores.

References

Berthet, P. & Boidin, J. 1966: Observations sur quelques Hymenomycetes ewcoltes en Republique Camerounaise. Cahiers Mabokè 4: 27-54.

Freeman, G. W. & Petersen, R. H. 1979: Studies in the genus Scytinostromella. Mycologia 71: 85-91.

Jülich, W. 1978: Studies in resupinate basidiomycetes V. Persoonia 10: 137-140.

MYCOTAXON

Vol. X, No. 2, pp. 288-292 January-March 1980

POCILLOPYCNIS, AN EMENDATION

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ABSTRACT

Pocillopycnis nomen anamorphosis, typified by *P. umensis*, is redescribed and illustrated from type material. Conidia are holoblastic on sympodially proliferating conidiogenous cells.

INTRODUCTION

Dyko & Sutton (1979) presented a well illustrated revision of *Linodochium* Höhnel (1909), *Pseudocenangium* Karsten (1886), *Septopatella* Petrak (1925), *Siroscyphella* Höhnel (1910), and introduced the anamorph genus, *Pocillopycnis* Dyko & Sutton. The brief protologue for *Pocillopycnis* stated: "Conidiomata pycnidial becoming cupulate, superficial, separate, composed of textura angularis. Ostiole absent. Conidiophores absent. Conidiogenous cells phialidic, hyaline, discrete, arising directly from the inner wall on the lower half of the conidiomata. Conidia enteroblastic, hyaline, lunate, euseptate." *Pocillopycnis umensis* (Bubák & Vleugel) Dyko & Sutton was compared to other similar but distinct anamorph taxa. *P. umensis* was excluded from *Pseudocenangium* because of differences in the morphology of the conidioma and conidiogenesis. The mode of "...conidium ontogeny excludes it from *Septopatella*,..." and the lack of "...conidiophores and of textura porrecta and textura oblita in the conidiomata exclude it from *Gelatinopycnis*" (Dyko & Sutton 1979). *Foveostroma drupacearum* (Lév.) DiCosmo, the type species of *Foveostroma* DiCosmo (1978) differs from *P. umensis* in morphology of conidioma and conidiophores.

Although *P. umensis* was excluded from a number of similar anamorph genera, the striking similarity between it and species of *Gelatinosporium* Peck char. emend. DiCosmo (DiCosmo 1978, Funk 1977, 1978), was not mentioned. This similarity prompted a reexamination of *P. umensis* which has brought to light several anomalies regarding *P. umensis* as delimited by Dyko & Sutton (1979). The mode of conidiogenesis was found not to be "enteroblastic" as originally described. Furthermore, the morphology of conidioma differs considerably from that apparent in the original description and illustrations. An emended description of *P. umensis* is presented.

TAXONOMIC PART

Pocillopycnis Dyko & Sutton char. emend. DiCosmo.

Conidiomata pycnidial, scattered to gregarious, discrete, initially immersed, ultimately becoming erumpent, subglobose to depressed globose, without a definite ostiole; wall composed of roughened pseudoparenchymatous cells forming a *textura globulosa* above, which differentiates to form *textura oblita* below. Conidiogenous cells proliferating sympodially, producing conidia on conspicuous pegs. Conidia holoblastic, straight or curved, lunate to irregularly sigmoid, septate, hyaline, smooth-walled.

Type species: *Pocillopycnis umensis* (Bubák & Vleugel) Dyko & Sutton.

Pocillopycnis umensis (Bubák & Vleugel) Dyko & Sutton char. emend. DiCosmo.

Conidiomata pycnidial, caulicolous, scattered to gregarious, initially immersed in outer cortical layers of the host (Fig. 1), ultimately erumpent, without a definite ostiole, dehiscent by irregular rupture of the apical tissue of *textura globulosa,* subglobose to depressed globose, glabrous, dark brown above, subhyaline below; up to 160 μ diam.; upper portion of the conidioma composed of dark brown to brown, minutely rouhgened pseudoparenchymatous cells forming a *textura globulosa* up to 25 μ thick, which differentiates to form a *textura oblita* (Fig. 8) up to 10 μ thick at the base. Conidiophores (Figs. 2-5) arising from the innermost hyphae of the locule and extending half way up the wall, simple or branched, septate, 10-20 X 3-4 μ, often reduced to simple conidiogenous cells 5-10 X 2.5-3.5 μ invested in a copious mucilaginous matrix. Conidiogenous cells proliferating sympodially 1-4 times, producing conidia on conspicuous pegs which are usually terminal but occasionally lateral. Conidia holoblastic, straight or curved, lunate to irregularlly sigmoid, hyaline, smooth-walled, 72-90 X 3-4 ($\bar{x}$=80 X 3.5) μ mean length/width ratio=23:1.

Host: On twigs of *Picea excelsa*.

Specimen examined: Holotype in BPI, J. Vleugel, Holmon, Umea Province, Sweden, July 1907.

DISCUSSION

As originally delimited (Dyko & Sutton 1979), *P. umensis* could well have been placed in *Gelatinosporium*; but this study has established that conidia of *P. umensis* are produced holoblastically on sympodially proliferating conidiogenous cells. This excludes it from *Gelatinosporium* which exhibits phialidic conidiogenesis.

The mature conidiomata of *P. umensis* were originally described as being superficial and composed of *textura angularis*. This could not be confirmed. In vertical section the conidiomata are immersed in the cortical layers of the host and ultimately become erumpent. Only when the host covering layer and the upper pseudoparenchymatous half of the conidiomata are lost do the structures become cupulate and appear superficial.

Figs. 1-8. *Pocillopycnis umensis*. 1. conidioma (vertical section) arrows indicate outer cortical layer. X200. 2. conidiogenous cell. X2000. 3. conidiogenous cell, note the septum (arrow). X2000. 4-5. conidiogenous cells with proliferation in mucilaginous matrix. X2000. 6. conidium. X1000.

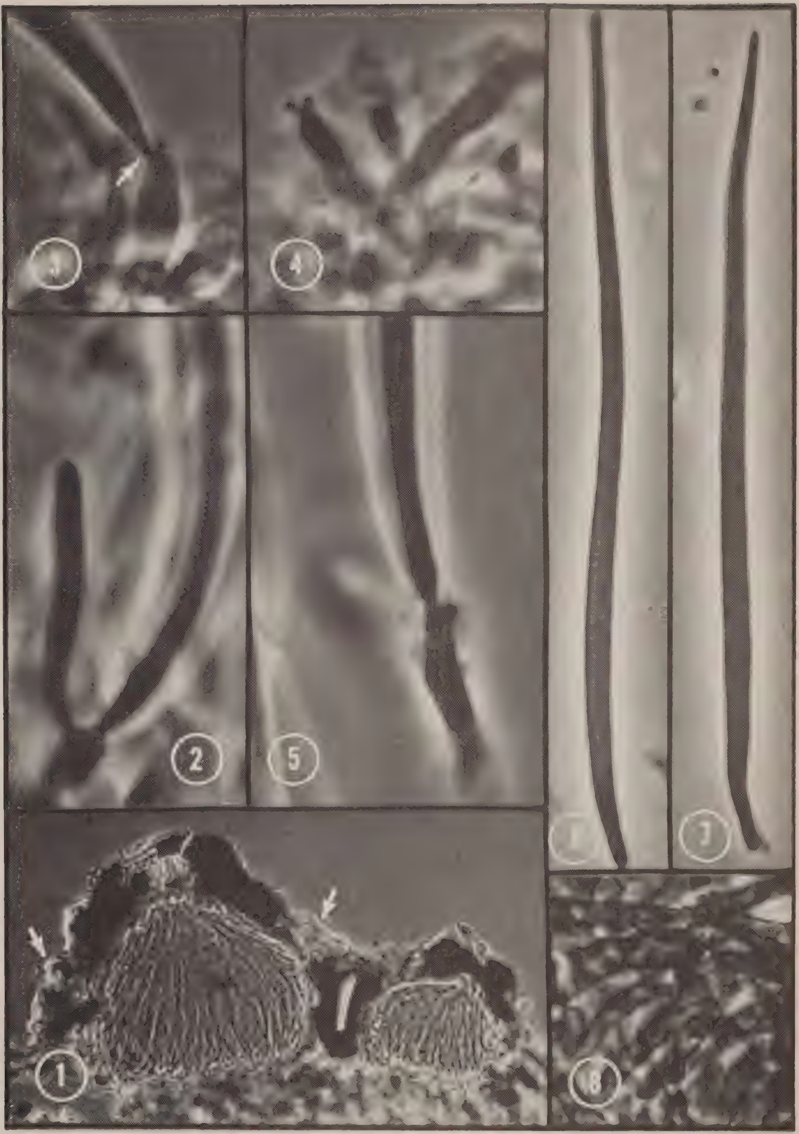

Fig. 7. conidium. X1000. 8. surface view of tissue type at base of conidioma. X2000.

ACKNOWLEDGEMENTS

I thank Dr. K.A. Pirozynski of the National Museums of Canada, Ottawa and Drs. W.B. Kendrick and T.R. NagRaj for reading a preliminary manuscript and making helpful criticisms. This research was supported in part by a grant made by the Natural Sciences and Engineering Research Council of Canada to Prof. W.B. Kendrick and by a Natural Sciences and Engineering Research Council of Canada Postgraduate Scholarship made to Frank DiCosmo.

LITERATURE CITED

DiCosmo, F. 1978. A revision of *Corniculariella*. Can. J. Bot. 56:1665-1690.

Dyko, B.J. and B.C. Sutton 1979. A revision of *Linodochium*, *Pseudocenangium*, *Septopatella*, and *Siroscyphella*. Can. J. Bot. 57:370-385.

Funk, A. 1977. The genus *Dermea* and related conidial states on Douglas fir. Can. J. Bot. 54:2852-2856.

Funk, A. 1978. New species of *Gelatinosporium* on western conifers. Can. J. Bot. 57:765-767.

Höhnel, F., von. 1909. Fragmente zur Mykologie. (VIII. Mitteilung, Nr. 354 bis 406.) Sitzungsber. Akad. Wiss. Wien Math. Naturwiss. Kl. Abt. 1, 118:1157-1246.

Höhnel, F., von. 1909. Fragmente zur Mykologie. (XI. Mitteilung, Nr. 527 bis 573.) Sitzungsber. Akad. Wiss. Wien Math. Naturwiss. Kl. Abt. 1, 127:617-679.

Karsten, P.A. 1886. Symbolae ad Mycologiam Fennicam. Part 17. Medd. Soc. Fauna Fl. Fenn. 13:159-165.

Petrak, F. 1925. Mykologische Notizen VIII. Ann. Mycol. 23:1-143.

MYCOTAXON

Vol. X. No. 2, pp. 293-295 January-March 1980

A NEW GENUS AND A NEW SPECIES OF CLATHRACEAE

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ABSTRACT
(AUSZUG)

Eine neue Gattung und eine neue Spezies sind in China gefunden worden. Wir schlage diesen Pilz als neu zu Mykologie zusammen mit Beischreibung in Latein vor: Abbildung und Photographie sind auch versorgt.

During the course of studies on a mycological field trip, a fungus specimen with certain interesting features was collected. A scrutiny of the available literature revealed it to be a new species of the Clathraceae and it is named and described here as Pseudoclathrus cylindrosporus.

Pseudoclathrus new genus

Pseudoclathrus Liu et Bau gen. nov.
Fructificatio stipitata; receptaculum e brachio recto isodiametro constatum; brachium exterior lato unilongitudinaliter sulcatum, apice connectum; sporae cylindracae.
Type species: Pseudoclathrus cylindrosporus

Sporocarps are stipitate. The receptacle is formed by erect ramifications (arms or laciniae) of equal diameter. Each ramification has a longitudinal sulcus (furrow) on its abaxial side. Ramifications are united at their apices. Spores are cylindrical.
Type species: Pseudoclathrus cylindrosporus Liu et Bau

The new genus is a taxon between Clathrus and Lysurus. It is especially close to Clathrus columnatus Bosc. and Lysurus mokusin (L. ex Pers.) Fr. In common with Clathrus are the vertical branches united at apex and never separated, but

Clathrus has neither a longitudinal sulcus on its abaxial side nor any kind of stipe. A longitudinal sulcus on abaxial side of ramification and a stipe are found in both Lysurus and the new genus, but the stipe of this new genus is amphi-complanate.

Pseudoclathrus cylindrosporus new species

Pseudoclathrus cylindrosporus Liu et Bau sp. nov.
Fructificatio 6cm. alto; receptaculum e sex brachio recto isodiametro constatum, 2.5cm. longum; brachium exterior lato unilongitudinaliter sulcatum, apice connectum, aurantiacum; gleba foetida brunnescenti-olivacea; stipes occultus, spongiosus albidus, compressus, hexagonus, 3.5cm. longus, 1-1.2cm. crassus; volva vaginiformis, alba, 3cm. alta; sporae cylindricae, dilute olivaceae, 2.8-4 x 1.2-1.5µm.
Hab. ad terram. Peking Municipality: Western Hill. 30 September 1948. Liu Bo (3471, Typus).

Sporocarps are 6cm. high. The receptacle consists of 6 erect arms (laciniae) in equal diameter and 2.5cm. high. A longitudinal furrow appears on outside part of each arm. Upper terminals of arms are united and never separated, and the arms are orange yellow in color. The gleba is on two sides of the arms, olive brown in color and foetid. The stipe is hidden in the volva. It is 3.5cm. long, 1-1.2cm. thick, spongy in texture, white colored, flat on both sides and with 6 longitudinal ridges (corresponding to the arms). The volva is scabbard-like, white, and 3cm. high. Spores are cylindrical, pale olive color, and 2.8-4 x 1.2-1.5µm. in size.

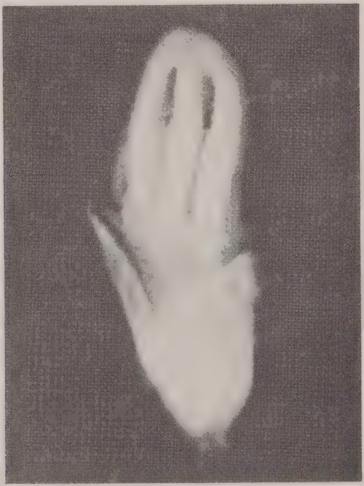

Fig. 1. Pseudoclathrus cylindrosporus Liu et Bau, showing sporocarp (about 3/4 natural size)

The type specimen was collected on the ground by Liu Bo on 30 September 1948 in Western Hill of Peking. It was then numbered 3471 and deposited in Biology Herbarium of the Shansi University in Taiyuan City of the Shansi Province, China.

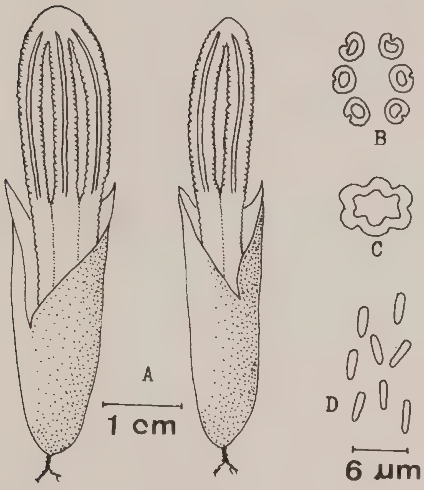

Fig. 2. *Pseudoclathrus cylindrosporus* Liu et Bau; A. sporocarp, front side view (left) and lateral side view (right); B. cross section of arms, showing furrows; C. cross section of stipe, showing ridges; and D. spores

Bibliography

Bessey, E.A. 1965. Morphology and taxonomy of fungi. New York : Hafner Publishing Co.

Clements, F.E. and C.L. Shear. 1964. The genera of fungi. New York : Hafner Publishing Co.

Dring, D.M. 1973. Gasteromycetes. In Ainsworth, G.C., F.K. Sparrow and A.S. Sussman (eds.). Fungi : An advanced treatise. Vol. 4B, pp. 451-478. New York : Academic Press.

Dring, D.M., J. Meeker and R. Goos. 1971. *Clathrus oahuensis*, a new species from Hawaii. Mycologia 63(4): 893-897.

Kawamura, S. 1954. Icones of Japanese fungi. Vol. 6. Tokyo : Kazamashobo.

Kluzak, Z. 1974. *Lysurus gardneri* Berk : a new species for Czechoslovakia. Česká Mykol. 28(3): 181-184.

Kozelnicky, G.M. and W.N. Garrett. 1966. The unusual occurrence of a stinkhorn fungus (*Clathrus ruber*) on golf turf. Plant Dis. Reporter 50(11): 840.

Semmens, E.J. 1967. Notes on the development and structure of the "Basket Fungus", *Clathrus gracilis* (Berk.) Schlechtendal. Muelleria 1(3): 219-221.

MYCOTAXON

Vol. X, No. 2, pp. 296-298 January-March 1980

A NEW SPECIES OF *AMANITA*

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ABSTRACT

Amanita pallidoflavescens (fig.1) is described and illustrated from Alabama. It is placed into the stirps *Cinereoconia* and compared with the other taxa therein.

Amanita pallidoflavescens Jenkins, sp. nov.
Holotype: Homewood Park, Birmingham, Alabama, 23. vii. 76, Wayne Harbin 1216(DTJ)*

Pileus quanto 35 mm latus, planus convexusque convertens in plano superficie diend in leviter depresso ad centrum, margo non striatus, albus ad argenteum albumque colorem, glaber; volva incomposite propensus, floccosa pulverulentaque, fusca canaque, facile removitus. Lamellae annexae ad ipsum liberantem statum, densae, fragiles, gilvae cum puniceocolore. Stipes quanto 40 x 8 mm; solidi, albi ad gilvum colorem, glaberosi ad fundum, bulbus ad basim sub radici, volva fusca canaque pulvis in humiliore stipte et bulbo ad basim; partialis tegumen superior, fugax alba. Caro pilei, stipitis atque bulbi ad basim sufflavus cum contusus. Sporae 8.6-10.2 x 4.7-5.5 μm, nonamyloideae.

PILEUS: up to 35 mm broad, plano-convex to plane to slightly depressed at center, margin non-striate, slightly appendiculate, pileipellis easily separable, white to silvery-white, glabrous, flesh white, up to 3 mm at center, tapering to margin; volval remnants as a thick, irregularly disposed, floccose-pulverulent layer, brownish-gray, thinning to absent on margin, easily removed. LAMELLAE: adnexed to just free, close, fragile, cream with pale pinkish tint, edges finely pulverulent; lamellulae numerous, attenuate. STIPE: up to 40 x 8 mm, tapering slightly downward, solid, white to cream, glabrous to near basal bulb, bulb subradicate, up to 20 x 12 mm; volval remnants as brownish-gray pulverulence on lower stipe and basal bulb, irregularly distributed; partial veil superior, fugacious, white. No distinct smell or taste. Flesh of pileus, stipe, and basal bulb turning yellowish upon bruising.

PILEIPELLIS: filamentous hyphae densely interwoven, very slightly gelatinized, hyaline to slightly yellowish in alkaline solution.
PILEUS TRAMA: filamentous hyphae undifferentiated, moderately branched, no clamps, up to 8 μm diam; inflated cells abundant, terminal or short, terminal chains, fusiform, clavate, to elliptic, up to 93 x 31 μm.

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* DTJ = The author's herbarium

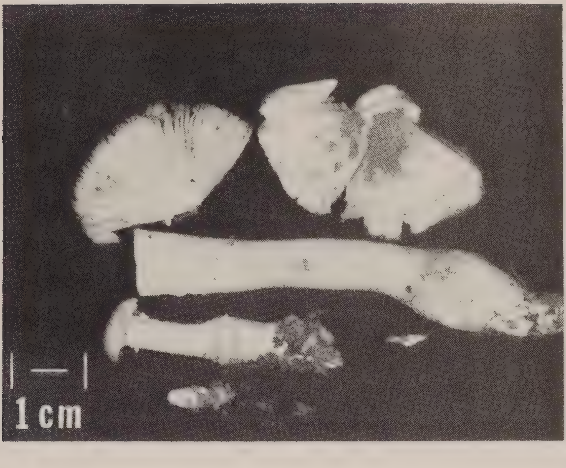

Fig. 1. *Amanita pallidoflavescens* Jenkins DTJ 1216

LAMELLA TRAMA: bilateral, filamentous hyphae undifferentiated, moderately branched, no clamps, up to 8 µm diam; inflated cells elongate, terminal. SUBHYMENIUM: hyphae ramose to slightly inflated ramose, clampless. BASIDIA: up to 43 x 3-8.5 µm, mostly 1- and 2-sterigmate, with some 4-sterigmate, thin walled, clampless. VOLVA: filamentous hyphae on pileus very sparse, clampless, sparsely branched, up to 9 µm diam; inflated cells very abundant, mostly broadly elliptic, pyriform, to elliptic, up to 70 x 54 µm, with few oblong elliptic to clavate, up to 30 x 12 µm, terminal or short, terminal chains, irregularly disposed, many pedicellate: tissue at base of stipe with more filamentous hyphae, similar to that on pileus; inflated cells mostly globose to subglobose, up to 65 x 65 µm, also broadly elliptic to clavate, not as many pedicellate, terminal or short, terminal chains, irregularly disposed. STIPE TRAMA: filamentous hyphae undifferentiated and conspicuous, sparsely branched, up to 9 µm diam, clampless; inflated cells terminal, clavate to oblong elliptic, longitudinally oriented, up to 218 x 25 µm. PARTIAL VEIL: filamentous hyphae dominant, moderately branched, up to 8 µmdiam, clampless; inflated cells abundant, very similar to those of volva.

SPORES: 4.7-5.5 x 8.6-10.2 µm ($\underline{E}$ = 1.56-2.17; $\underline{\overline{E}^m}$ = 1.76), elliptical to cylindrical, often adaxially flattened, hyaline, amyloid, thin walled; contents guttulate; apiculus sublateral, short cylindrical.

Habitat and distribution: terrestrial, mixed coniferous and deciduous forest, stream bank, Birmingham, Alabama.

Collections examined: Homewood Park, Birmingham, Alabama, 23. vii. 76, Wayne Harbin 1216(DTJ); Homewood Park, Birmingham, Alabama, 10. vi. 79, David T. Jenkins 1496(DTJ).

DISCUSSION

Amanita sect. *Lepidella*, subsect. *Solitariae*, stirps *Cinereoconia* is characterized by small to medium fruit bodies, a grayish or brownish, pulverulent volva, elliptical to cylindrical spores, and clampless basidia (Bas, 1969). By all of these characters, A. *pallidoflavescens* fits comfortably in the stirps. It also shares certain specific characters of other members of this stirps, *viz.*, a yellowish staining reaction of the flesh, similar to that in A. *cinereoconia* var. *croceescens* and A. *lutescens*; a spore size similar to A. *cinereoconia* var. *cinereoconia*, A. *lutescens*, and A. *odorata*; and an irregular orientation of volval elements similar to A. *lutescens*, A. *griseofarinosa*, and A. *vestita*. The uniqueness of this organism results from a combination of the above characters with a white to silvery-white pileus, cream colored gills with a faint pinkish tint, and basidia that are mostly 1- and 2-sterigmate.

LITERATURE CITED

Bas, C. 1969. Morphology and Subdivision of *Amanita* and a Monograph on its Section *Lepidella*. Persoonia 5(4): 462.

MYCOTAXON

Vol. X, No. 2, pp. 299-349 January-March 1980

NOTES ON COLORADO FUNGI IV: *MYXOMYCETES*

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INTRODUCTION

Since Sturgis published his article "The *Myxomycetes* of Colorado II" in 1913 (32), no attempt has been made to record the myxomycete flora of the State. In his first paper in 1907, Sturgis (31) listed 94 species and described 2 new varieties. In his second paper he added 33 other species for a total of 127 prior to 1913. However, some of these records are in doubt. In his first paper Sturgis reported 7 species which he had not found but were listed with a reference to a manuscript of Macbride's which recorded them as occurring in Colorado. Apparently this manuscript was never published and, since five of the seven were never listed by Macbride as occurring in Colorado in either his 1899 or 1922 editions of *The North American Slime-Moulds* (26, 27), there is serious doubt that they had actually been found in Colorado prior to 1907. Two have not yet been specifically reported from Colorado. A few taxa, reported by Sturgis as varieties, are now given species rank, but many he listed as species have now been placed in synonymy so that of the 127 he reported only 116 are now considered valid. During the past sixty-five years, 54 more have been recorded from Colorado by various authors bringing the total to 170. Of necessity most publications record the distribution of many common species as "cosmopolitan" or "world-wide" or "throughout North America" without enumerating specific states in which these species have been recorded. This makes verification of records for any given state difficult to impossible without searching all the herbaria for collections from that state.

In an attempt to update the Colorado flora we have compiled a chart (Figure 1) which shows the 170 species previously specifically reported from Colorado, the 2 unverified ones reported by Sturgis, 4 found as Colorado collections in the U.S.D.A. Herbarium at Beltsville, Md. (BPI), and 49 which have been collected and, for the greater part, identified by the first two authors over the past ten years. Some of the latter are new records for Colorado and some are merely verified Colorado collections of species generally described as occurring in this region but not specifically reported from the State. This brings the total to 225 species reported from Colorado to date. The number of collections of each species now in the Denver Botanic Gardens

Herbarium of Fungi (DBG) is stated. The small number of specimens of *Licea* and other slime molds too minute to be readily visible with a 10x lens, is probably due to our relying almost entirely on field work, only recently supplemented by moist chamber cultures.

The differences between Sturgis' list and ours, we feel, are due not only to the different collecting techniques but also to the changes that have occurred in the ecology of Colorado in the past 65 years. Though Sturgis and his ardent collector, Professor Ellsworth Bethel, found many species on the plains between 1,500 and 2,150 m (±5,000 and 7,000 feet) elevation in Denver, Aurora and Colorado Springs, we have not found slime molds (except for a few moist chamber fruitings) in these areas which are now part of the front range urban sprawl of highly developed industrial and residential suburbs. Presumably the slime molds have disappeared with the destruction of their habitat or what few are left are on inaccessible private property. Conversely, Sturgis and Bethel rarely collected above 2,750 m (9,000 ft), presumably because of limited access to the forest above the railroad terminals. They also evidently collected only in the summer months, but during this time apparently did so daily without interruption in a given area. Most of our collecting has been done in the montane and subalpine life zones of the mountains of central Colorado between 2,150 m (7,000 ft) and timberline, ±3,500 m (11,500 ft), and, though we collected only sporadically on weekends and holidays, we continued from March through November. Most of the species we have found that Sturgis did not record were gathered in the early spring or at high altitudes near the edge of melting snowbanks. Sturgis p. 449 (32) stated that he could not account for the rarity of "species of *Lamproderma* in the mountainous districts of Colorado". The reason now is obvious; most of the Colorado *Lamproderma* species fruit only in the early spring near melting snow, when he was not collecting.

The area in which most of our collections have been made is generally within the range of the aspen tree, *Populus tremuloides* Michx. whose decayed wood and bark form a common substrate for species of myxomycetes. Decayed spruce and fir logs and litter, as well as dead grass and shrubs, at the edge of melting snowbanks are also likely sites for fruitings. As noted by previous authors (11,20,22,30), many alpine collections are more robust and have spores 1-2 µm larger in diameter than lowland collections of the same species.

In this region there are generally two fruiting seasons: 1) at the edge of melting snowbanks in the spring and early summer; and 2) during rainy periods in the late summer and early fall. Thus the date of fruiting is not meaningful unless the location is also considered since the "snowbank flora" may start maturing in the foothills in early March and still be fruiting in late July at timberline, and the summer flora may start in June and last until November depending on the season. We have therefore, when possible, listed the species as "snowbank (SB)", "summer (S)", "both (B)", or "moist chamber (MC)" in the chart.

FIGURE 1

Name	Seasonal Occurrence	Number of DBG Collections	Previous Colorado Citation	Remarks
CERATIOMYXALES				
CERATIOMYXACEAE				
Ceratiomyxa fruticulosa (Müll.) Macbr.	B	10	(31)	
LICEALES				
CRIBRARIACEAE				
Cribraria argillacea (Pers.) Pers.	S	12	(31)	
C. atrofusca Martin & Lovejoy	S	1	(29)	type locality
C. aurantiaca Schrad.		0	(31)	
C. elegans Berk. & Curt.		0	(31)BPI	verifying record
C. intricata Schrad.		0	(31)	unverified
C. macrocarpa Schrad.	S	0	(31)	
C. microcarpa (Schrad.) Pers.	MC	2	(12)	
C. minutissima Schw.		0	(31)	
C. oregana H. C. Gilbert	B	9		new Colorado record
C. piriformis Schrad.	S	0	(32)	
C. purpurea Schrad.	S	2	(27)	
C. rufa (Roth) Rost.	S	4		verifying record
C. violacea Rex	S	0	(31)	
C. vulgaris Schrad.		0	BPI	verifying record
Dictydium cancellatum (Batsch) Macbr.		1	(31)	
D. mirabile (Rost.) Meylan	S	17	(31)	
Lindbladia tubulina Fries	S	9	(31)	
LICEACEAE				
Licea belmontiana Nann.-Brem.	MC	18		new hemisphere record
L. castanea G. Lister	MC	2		new Colorado record
L. fimicola Dearness & Bisby	MC	0	(30)	

SB=snowbank; S=summer; B=both; MC-moist chamber

Name	Seasonal Occurrence	Number of DBG Collections	Previous Colorado Citation	Remarks
LICEALES (CONT.)				
LICEACEAE (CONT.)				
Licea kleistobolus Martin	MC	4	(12)	
L. minima Fries		2	(28)	
L. parasitica (Zukal) Martin	MC	4		verifying record
L. tenera Jahn	MC	0	(2)	
L. variabilis Schrad.		0	(32)	
RETICULARIACEAE				
Dictydiaethalium plumbeum (Schum.) Rost.		0	(31)	
Enteridium lycoperdon (Bull.) Farr	S	8	(31)	
E. olivaceum Ehrenb.	S	1	(31)	
E. splendens (Morgan) Macbr.		1	(31)	
E. splendens var. jurana (Meyl.) Härk.	S	5		new Colorado record
Lycogala epidendrum (L.) Fries	B	24	(26)	
L. flavofuscum (Ehrenb.) Rost.		0	(31)	
Tubifera ferruginosa (Batsch) J.F. Gmel.	S	9	(31)	
ECHINOSTELIALES				
ECHINOSTELIACEAE				
Echinostelium elachiston Alexop.	MC	0	(30)	
TRICHIALES				
DIANEMACEAE				
Calomyxa metallica (Berk.) Nieuwl.	MC	4	(12)	
Dianema corticatum A. Lister	B	6	(23)	
D. depressum (A. Lister) A. Lister	MC-B	8	(12)	
D. harveyi Rex	MC-S	1	(23)	
D. subretisporum Kowalski	SB	2		new Colorado record

TRICHIACEAE				
Arcyodes incarnata (Alb. & Schw.) O.F. Cook	B	10	(12)	
Arcyria cinerea (Bull.) Pers.	MC-B	38	(31)	
A. denudata (L.) Wettst.		0	(26)	
A. ferruginea Sauter	S	0	(32)	
A. globosa Schw.	S	5		new Colorado record on new substrate
A. incarnata (Pers.) Pers.	B	44	(31)	
A. insignis Kalchbr. & Cooke	MC	1		verifying record
A. nutans (Bull.) Grev.	S	18	(31)	
A. oerstedtii Rost.	S	6	(13)	
A. olivaceoglobosa Farr, Chapman & Mitchel	S	1	(11a)	type collection
A. pomiformis (Leers) Rost.	S	5	(31)	
A. stipata (Schw.) A. Lister	B	5	(31)	
A. versicolor Phill.	B	47	(31)	
Hemitrichia abietina (Wigand) G. Lister		0	(31)	
H. calyculata (Speg.) Farr	S	1		verifying record
H. clavata (Pers.) Rost.	B	38	(26)	
H. karstenii (Rost.) A. Lister	B	1	(32)	
H. montana (Morgan) Macbr.	B	22	(30)	
H. serpula (Scop.) Rost.	S	0	(32)	
Metatrichia vesparium (Batsch) Nann.-Brem.	B	16	(32)	
Oligonema fulvum Morgan	S	1	(30)	
O. schweinitzii (Berk.) Martin	S	1		new Colorado record
Perichaena chrysosperma (Currey) A. Lister	MC	3		verifying record
P. corticalis (Batsch) Rost.	B	40	(31)	
P. depressa Libert	MC	26	(31)	
P. vermicularis (Schw.) Rost.	MC-S	6	(32)	
Prototrichia metallica (Berk.) Massee	B	71	(26)	
Trichia alpina (R. E. Fries) Meylan	B	10		new Colorado record
T. botrytis (J. F. Gmel.) Pers.	B	3	(31)	
T. contorta (Ditmar) Rost.	B	40	(31)	
T. decipiens (Pers.) Macbr.	MC-B	55	(31)	
T. favoginea (Batsch) Pers.	S	38	(31)	

SB=snowbank; S-summer; B-both; MC-moist chamber

Name	Seasonal Occurrence	Number of DBG Collections	Previous Colorado Citation	Remarks
TRICHIALES (CONT.)				
TRICHIACEAE (CONT.)				
Trichia floriformis (Schw.) G. Lister	S	2		verifying record
T. lutescens (A. Lister) A. Lister	S	3	(28)	
T. scabra Rost.	B	8		verifying record
T. subfusca Rex	SB	10		verifying record
T. varia (Pers.) Pers.	B	89	(31)	
PHYSARALES				
DIDYMIACEAE				
Diachea leucopodia (Bull.) Rost.		0	(31)	
D. subsessilis Peck		0	(32)	
Diderma asteroides (A.& G. Lister) G. Lister	B	7	(32)	
D. brooksii Kowalski	SB	3		new Colorado record
D. chondrioderma (de Bary & Rost.) G. Lister		0	(30)	
D. cor-rubrum Macbr.		0	(30)	
D. crustaceum Peck	SB	1	(31)	verifying record
D. effusum (Schw.) Morgan	S	0	(32)	
D. floriforme (Bull.) Pers.	S	2		verifying record
D. globosum Pers.		2	(31)	
D. hemisphaericum (Bull.) Hornem.	S	0	(31)	
D. lyallii (Massee) Macbr.	SB	92	(30)	
D. montanum (Meylan) Meylan	B	55	(28)	
D. niveum (Rost.) Macbr.	B	81	(31)	
D. radiatum (L.) Morgan	B	6	(31)	
D. roanense (Rex) Macbr.	S	2	(23)	
D. sauteri (Rost.) Macbr.		0	(31)	unverified
D. spumarioides (Fries) Fries	S	4	(31)	
D. testaceum (Schrad.) Pers.	S	0	(31)	
D. trevelyani (Grev.) Fries	B	10	(31)	

Didymium anellus Morgan	MC-S	3	(31)	
D. clavus (Alb. & Schw.) Rab.	S	2	(32)	
D. crustaceum Fries	S	3	(32)	
D. decipiens Meylan	SB	1		new hemisphere record
D. difforme (Pers.) S. F. Gray	S	0	(31)	
D. dubium Rost.	SB	26	(28)	
D. fulvum Sturgis	MC-S	3	(33)	type locality
D. megalosporum Berk. & Curt.		0	(31)	
D. melanospermum (Pers.) Macbr.	B	15	(31)	
D. minus (A. Lister) Morgan	S	1		verifying record
D. nigripes (Link) Fries	S	1	(31)	
D. nivicolum Meylan	SB	23		new Colorado record
D. quitense (Pat.) Torrend	SB	8	(32)	
D. squamulosum (Alb. & Schw.) Fries	MC-S	18	(31)	
D. sturgisii Hagelst.	MC-S	2	(32)	type locality
Lepidoderma carestianum (Rab.) Rost.	SB	18		new Colorado record
L. chailletii Rost.	SB	12		new Colorado record
L. granuliferum (Phill.) R. E. Fries	SB	1		new Colorado record
L. tigrinum (Schrad.) Rost.	S	3	(32)	
Mucilago crustacea Wiggers	MC-S	1	(31)	
PHYSARACEAE				
Badhamia affinis Rost.	MC-S	5	(31)	
B. capsulifera (Bull.) Berk.	MC-S	1	(28)	
B. dearnessii Hagelst.	S	5		new Colorado record
B. foliicola A. Lister	MC-S	13		verifying record
B. gracilis (Macbr.) Macbr.	MC	24	(32)	type locality
B. macrocarpa (Ces.) Rost.	MC-B	6	(32)	
B. nitens Berk.	S	0	(31)	
B. ovispora Racib.	S	0	(12)	
B. panicea (Fries) Rost.	MC-S	7	(31)	
B. populina A. & G. Lister	MC-S	2	(31)	
B. utricularis (Bull.) Berk.	B	30	(31)	

SB=snowbank; S=summer; B=both; MC-moist chamber

Name	Seasonal Occurrence	Number of DBG Collections	Previous Colorado Citation	Remarks
PHYSARALES (CONT.)				
PHYSARACEAE (CONT.)				
Badhamia versicolor A. Lister	MC-S	1	(31)	
Badhamiopsis ainoae (Yama.) Brooks & Keller	MC	9		new Colorado record
Cienkowskia reticulata (Alb. & Schw.) Rost.	S	3	(31)	
Craterium aureum (Schum.) Rost.	S	1	(23)	
C. leucocephalum (Pers.) Ditmar	MC-S	23	(31)	
C. minutum (Leers) Fries	S	7	(31)	
C. obovatum Peck		1	BPI	verifying record
Fuligo cinerea (Schw.) Morgan	MC	1	(31)	
F. intermedia Macbr.	B	5	(27)	type locality
F. megaspora Sturgis	S	0	(32)	type locality
F. septica (L.) Wiggers	B	20	(31)	
Leocarpus fragilis (Dicks.) Rost.	B	30	(31)	
Physarum albescens Ellis, ex Macbr.	SB	173	(26)	type locality
P. alpinum (A. & G. Lister) G. Lister	SB	8		new Colorado record
P. ?auriscalpium Cooke	MC	23	(31)	
P. bethelii Macbr., ex Lister	S	22	(32)	type locality
P. bitectum G. Lister	B	26	(27)	
P. bivalve Pers.	S	4	(31)	
P. bogoriense Racib.	S	4	(31)	
P. brunneolum (Phill.) Massee	S	1	(32)	
P. carneum G. Lister & Sturgis	S	1	(24)	type locality
P. cinereum (Batsch) Pers.	S	8	(31)	
P. citrinum Schum.		0	(27)	
P. compressum Alb. & Schw.	MC	3	(31)	
P. conglomeratum (Fries) Rost.	S	1		new Colorado record
P. contextum (Pers.) Pers.	S	6	(31)	
P. decipiens Curtis	S	7	(32)	
P. diderma Rost.	S	1	(31)	
P. didermoides (Pers.) Rost.	S	0	(31)	

P. famintzinii Rost.	S	1		new Colorado record
P. flavicomum Berk.	S	0	(31)	
P. globuliferum (Bull.) Pers.		0	BPI	verifying record
P. gyrosum Rost.	MC	19		new Colorado record
P. lateritium (Berk. & Rav.) Morgan		0	(31)	
P. leucophaeum Fries	S	5	(32)	
P. leucopus Link	S	10	(32)	
P. listeri Macbr.	S	0	(32)	
P. luteolum Peck	SB	1	(12)	
P. megalosporum Macbr.	MC	1	(33)	type locality
P. mortonii Macbr.		0	(23)	
P. newtonii Macbr.		0	(25)	type locality
P. notabile Macbr.	S	57	(12)	
P. nudum Macbr.	MC-S	5		new Colorado record
P. nutans Pers.	S	53	(31)	
P. oblatum Macbr.	S	2	(32)	
P. polycephalum Schw.	MC	1		verifying record
P. pulcherrimum Berk. & Rav.		0	(30)	
P. pusillum (Berk. & Curt.) G. Lister	MC-S	19	(32)	
P. rubiginosum Fries	S	5	(27)	
P. stellatum (Massee) Martin	S	5	(31)	verifying record
P. sulphureum Alb. & Schw.		0	(23)	
P. superbum Hagelst.	SB	1		verifying record
P. vernum Somm.	B	24	(31)	
P. virescens Ditmar	S	0	(32)	
P. viride (Bull.) Pers.	S	18	(31)	
Protophysarum phloiogenum Blackwell & Alexop.	MC	15	(4)	type locality
STEMONITALES				
STEMONITACEAE				
Amaurochaete atra (Alb. & Schw.) Rost.		0	(27)	
A. ferruginea Macbr. & Martin		0	(30)	
Comatricha aequalis Peck		0	(31)	

SB=snowbank; S=summer; B=both; MC=moist chamber

Name	Seasonal Occurrence	Number of DBG Collections	Previous Colorado Citation	Remarks
STEMONITALES (CONT.)				
STEMONITACEAE (CONT.)				
Comatricha alpina Kowalski	SB	4		new Colorado record
C. elegans (Racib.) G. Lister	MC-S	12	(32)	
C. fimbriata G. Lister & Cran	MC-S	2		new Colorado record
C. irregularis Rex	S	1	(31)	
C. laxa Rost.	MC-B	21	(31)	
C. nigra (Pers.) Schroet.	B	65	(31)	
C. pulchella (C. Bab.) Rost.	S	1	(31)	
C. rubens A. Lister	S	1	(23)	
C. suksdorfii Ellis & Ev.	SB	35	(31)	
C. typhoides (Bull.) Rost.	S	21	(31)	
C. sp.(? nodulifera Wollm. & Alexop.)	SB	50		new Colorado record
Enerthenema berkeleyanum Rost.	S	0	(32)	
E. melanospermum Macbr. & Martin	SB	36		new Colorado record
E. papillatum (Pers.) Rost.	S	32	(31)	
Lamproderma arcyrioides (Sommerf.) Rost.	SB	17	(31)	
L. atrosporum Meylan	SB	52		verifying record
L. carestiae (Ces.& de Not.) Meylan	SB	32	(12)	
L. columbinum (Pers.) Rost.	S	5		verifying record
L. cribrarioides (Fries) R. E. Fries	SB	10	(28)	
L. cristatum Meylan	SB	1		new hemisphere record
L. echinosporum Meylan	SB	37		new Colorado record
L. fuscatum Meylan	SB	3		new Colorado record
L. gulielmae Meylan		0	(23)	
L. maculatum Kowalski	SB	1		new Colorado record
L. sauteri Rost.	SB	60	(31)	
L. scintillans (Berk. & Br.) Morgan	S	2	(32)	
Leptoderma iridescens G. Lister	S	2	(12)	
Stemonitis axifera (Bull.) Macbr.	S	11	(31)	
S. confluens Cooke & Ellis	S	1	(31)	

S. flavogenita Jahn	S	16		verifying record
S. fusca Roth	S	46	(31)	
S. herbatica Peck	S	6	(31)	
S. hyperopta Meylan		0	(12)	
S. nigrescens Rex		0	BPI	verifying record
S. smithii Macbr.	S	3	(31)	
S. splendens Rost.		0	(31)	
S. uvifera Macbr.	S	1		new Colorado record
S. virginiensis Rex	S	4	(12)	

SB=snowbank; S=summer; B=both; MC=moist chamber

ANNOTATED LIST OF SPECIES

The species of myxomycetes are listed in alphabetical order within the genera which, in turn, are arranged alphabetically within the families and they, under the orders: Ceratiomyxales, Liceales, Trichiales, Echinosteliales, Physarales and Stemonitales. The genus *Diachea* is placed in the Physarales rather than in the Stemonitales, as suggested by recent studies (1,10,11). We have followed Kowalski's (17,18) example in recording spore size to include ornamentation. In the interest of brevity, collection data are provided only on species not previously reported from Colorado. The localities are cited by counties. Unless more counties are represented, no more than five citations are given regardless of the total number of collections in the DBG herbarium. Only when our collections vary significantly from the type descriptions or the descriptions in Martin and Alexopoulos' *The Myxomycetes* (30) are observations made. Collection numbers are all (DBG) unless otherwise noted. Numbered color designations are from ISCC-NBS Centroid Color Charts (3).

ORDER CERATIOMYXALES

Ceratiomyxa fruticulosa (Müll.) Macbr., No. Am. Slime-Moulds 18. 1899.

Reported from Colorado by Sturgis in 1907, p. 11 (31)as *C. mucida* (Pers.) Schroet. from Boulder, El Paso, Gilpin, Jefferson, Ouray and San Juan counties.

Collected also in Clear Creek, Custer, Eagle, Garfield and Larimer counties and seen but not collected in many other areas over the State on decayed wood from early spring to late fall.

ORDER LICEALES

FAMILY CRIBRARIACEAE

Cribraria argillacea (Pers.) Pers., Neues Mag. Bot. 1:91. 1794.

Reported from Colorado by Sturgis in 1907, p. 35 (31)from Boulder, El Paso, and Gilpin counties.

Collected also in Clear Creek, Custer, Eagle, Larimer and Mineral counties on decayed wood that is often covered with moss and lichens, in spruce/fir forests in summer.

Cribraria atrofusca Martin & Lovejoy, Jour. Wash. Acad. 22:92. 1932.

Type locality: Colorado.

Reported from Colorado in the original description from a collection on coniferous wood, in 1909 (29). The county was not cited.

Collected in Eagle and Larimer counties on decayed wood of Englemann spruce in summer.

Cribraria aurantiaca Schrad., Nov. Gen. Pl. 5. 1797.

Reported from Colorado by Sturgis in 1907, p. 35 (31) from El Paso and Douglas counties.

Collected also in Custer County by Sturgis in July, 1912, two specimens in BPI.

Cribraria elegans Berk. & Curt., in Berk., Grevillea 2:67. 1837.

Reported from Colorado by Sturgis in 1907, p. 35 (31) quoting

Macbride's manuscript. A specimen from Tolland (Boulder County) determined by T. H. Macbride, dated 1906, is in BPI, as is a collection from Estes Park (Larimer County).

Cribraria intricata Schrad., Nov. Gen. Pl. 7. 1797.

Reported from Colorado by Sturgis in 1907, p. 36 (31) quoting Macbride's manuscript but not found by Sturgis or by us and there are no Colorado collections in BPI, COLO or RM.

Cribraria macrocarpa Schrad., Nov. Gen. Pl. 8. 1797.

Reported from Colorado by Sturgis in 1907, p. 35 (31) from a collection made in August, 1905 in Douglas County. A collection made by Bethel in August, 1905 in El Paso County is in BPI.

Cribraria microcarpa (Schrad.) Pers., Syn. Fung. 190. 1801. emend Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69:340. 1966.

Reported from Colorado by Hagelstein in 1944, p. 198 (12).

Appeared in moist chamber on decayed wood collected in Clear Creek County.

Cribraria minutissima Schw., Trans. Am. Phil. Soc. II 4:260. 1832.

Reported from Colorado by Sturgis in 1907, p. 35 (31)from Boulder and El Paso counties.

Cribraria oregana H.C. Gilbert, in Peck and Gilbert, Am. Jour. Bot. 19:142. 1932.

New Colorado record.

Clear Creek Co.: On underside of decayed Englemann spruce, Chicago Creek (11 km southwest of Idaho Springs on Colo. 103) 2,500 m, August 3, 1974, *4697*; on decayed wood, Squaw Pass (9.5 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, September 27, 1975, *6350*; August 7, 1976, *6991*.

Eagle Co.: On decayed spruce, West Lake Creek (9.5 km south of I-70) 2,800 m, July 27, 1973, *3939*; on decayed Englemann spruce near melting snow, West Lake Creek (11 km south of I-70) 3,000 m, June 29, 1975, *5808*.

Cribraria piriformis Schrad., Nov. Gen. Pl. 4. 1797.

Reported from Colorado by Sturgis in 1913, p. 450 (32) as *C. "pyriformis"* Schrad. from collections made in Custer County in July and August, 1912.

Cribraria purpurea Schrad., Nov. Gen. Pl. 8. 1797.

Reported from Colorado by Macbride in 1922, p. 228 (27).

Collected in Clear Creek, Custer, Eagle, Mesa and Summit counties on decayed conifer wood in late summer and fall.

Cribraria rufa (Roth) Rost., Mon. 232. 1875.

Described by Martin and Alexopoulos, p. 89 (30) as being widely distributed throughout the United States, but not specifically reported from Colorado.

Clear Creek Co.: On decayed conifer wood, Squaw Pass (9.5 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, August 28, 1977, *8232*.

Eagle Co.: On decayed conifer wood, West Lake Creek (9.5 km south of I-70) 2,800 m, October 11, 1975, *6426*.

Gilpin Co.: On decayed conifer wood, Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, September 10, 1975, *6091*.

Larimer Co.: A specimen from Estes Park is in BPI.

Summit Co.: On decayed conifer wood, Spring Creek (22 km southwest of Kremmling on Colo. 9) 2,600 m, July 28, 1973, *3831*.

Cribraria violacea Rex, Proc. Acad. Phila. 43:393. 1891.

Reported by Sturgis in 1907, p. 36 (31) from collections on the inner bark of cottonwood logs, El Paso County, September 1906.

Cribraria vulgaris Schrad., Nov. Gen. Pl. 5. 1797.

Described by Martin and Alexopoulos, p. 91 (30) as occurring in the United States but not specifically reported from Colorado.

A collection of Bethel's dated 1909 is in BPI.

Dictydium cancellatum (Batsch) Macbr., N. Am. Slime-Moulds 172. 1899.

Reported from Colorado by Sturgis in 1907, p. 36 (31) from collections in Denver, Douglas, El Paso, Gilpin, Grand, Jefferson and San Juan counties.

Observations: Sturgis (31) noted that the specimens from El Paso County showed an irregular net over the apex of the sporangium which he recognized as an "abnormal form called by Rostafinski *Heterodictyon*,...closely resembling *Cribraria*". This taxon was given variety status by Lister in 1911 (23) as *D. cancellatum* var. *alpinum* and is now accepted as a distinct species *D. mirabile* (Rost.) Meylan. All DBG material and all the Colorado specimens we have examined in BPI fit the description of *D. mirabile*, however a Boulder County collection (COLO *M-821*) is typical *D. cancellatum*.

Dictydium mirabile (Rost.) Meylan, Bull. Soc. Vaud. Sci. Nat. 57:305. 1931.

Reported from Colorado by Sturgis in 1907, p. 36 (31) as "abnormal form" of *D. cancellatum* from collections in El Paso County (see above).

Collected also in Clear Creek, Eagle, Gilpin, and Summit counties on decayed conifer wood in summer.

Observations: Though not so described or illustrated in Martin and Alexopoulos, all our material shows the ribs to be connected by delicate transverse bands (as in *D. cancellatum*) in the lower half of the sporangium after the fugacious calyculus disappears. The *Cribraria*-like net over the upper part does not have these bands. The plasmodium is jet black.

Lindbladia tubulina Fries, Summa Veg. Scand. 449. 1849.

Reported from Colorado by Sturgis in 1907, p. 35 (31) as *L. effusa* (Ehr.) Rost. from collections in El Paso and Jefferson counties.

Collected also in Clear Creek, Eagle, Gilpin, Gunnison, Larimer and Mineral counties on moss and lichen-covered decayed conifer logs, mostly spruce, in summer.

FAMILY LICEACEAE

Licea belmontiana Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69:337.1966.

New hemisphere record.

Arapahoe Co.: On bark of living elm and dead cottonwood in moist chamber, High Line Canal and South University Boulevard, 1,620 m, 1978, *8558* (determination confirmed by E. Nannenga-Bremekamp).

Boulder Co.: On bark of cottonwood in moist chamber, 1.6 km east of Niwot, 1,680 m, 1979, *9324*.

El Paso Co.: On bark of scrub oak in moist chamber, Helen Hunt's grave, 2,850 m, 1978, *8858*.

Jefferson Co.: On bark of living cottonwood, elm and juniper in moist chamber, Mount Olivet cemetery 1,640 m, 1978, *8390*.

San Miguel Co.: On bark of cottonwood in moist chamber, Ilium, 2,100 m, 1978, *9301*.

Licea castanea G. Lister, Jour. Bot. 49:61. 1911.

New Colorado record.

Denver Co.: On bark of living juniper in moist chamber, Robinson Park (1st and Forest streets) 1,600 m, 1978, *8529*.

San Miguel Co.: On bark of living narrow leaf cottonwood in moist chamber, Ilium, 2,100 m, 1978, *9255*.

Licea fimicola Dearness & Bisby, in Bisby, Buller and Dearness, Fungi Manit. 52. 1929.

Reported from Colorado by Martin and Alexopoulos in 1969, p. 44 (30) from moist chamber fruitings on cow and rabbit dung, and by Angel and Wicklow in 1975 (2) from moist chamber fruitings on pronghorned antelope dung collected in the Pawnee Grasslands in Weld County.

Licea kleistobolus Martin, Mycologia 34:702. 1942.

Reported from Colorado by Hagelstein in 1944, p. 210 (12) as *Orcadella pusilla* (Lipp.) Hagelst.

Collected in Boulder, Denver and Saguache counties on bark of cottonwood, scrub oak and juniper in moist chamber.

Licea minima Fries, Syst. Myc. 3:199. 1829.

Reported from Colorado by Macbride and Martin in 1934, p. 225 (28) from a collection on an old polypore.

Collected in Clear Creek and Eagle counties on decayed wood in spring.

Licea parasitica (Zukal) Martin, Mycologia 34:702. 1942.

Described by Martin and Alexopoulos, p. 46 (30) as being widely distributed, but not specifically reported from Colorado.

Boulder Co.: On bark of American elm in moist chamber, 7 km north of Lafayette on U.S. 287, 1,600 m, 1979, *9397*.

San Miguel Co.: On narrow leaf cottonwood bark, in moist chamber, Ilium, 2,100 m, 1978, *9255*; Saw Pit, 2,200 m, 1978, *9221*, *9222*.

Licea tenera Jahn, Ber. Deuts. Bot. Ges. 36:665. 1919.

Reported from Colorado by Angel and Wicklow in 1975 (2) from moist chamber fruitings on dung of cow, rabbit and pronghorned antelope, collected in the Pawnee Grasslands in Weld County.

Licea variabilis Schrad., Nov. Gen. Pl. 18. 1797.

Reported from Colorado by Sturgis in 1913, p. 450 (32) as *L. flexuosa* Pers. from a scanty collection on decayed conifer wood on Cheyenne Mountain in El Paso County.

Collected also in Boulder County, exsiccati in COLO.

FAMILY RETICULARIACEAE

Dictydiaethalium plumbeum (Schum.) Rost., in Lister, Mycet. 157. 1894.
Reported from Colorado by Sturgis in 1907, p. 36 (31) from specimens collected by Bethel in Boulder and El Paso counties.

Enteridium lycoperdon (Bull.) Farr, Taxon 25:514. 1976.
Reported from Colorado by Sturgis in 1907, p. 37 (31) as *Reticularia Lycoperdon* Bull. He stated that it appeared to be common throughout the state, occurring frequently on rotting portions of living trees.

Collected in Archuleta, Boulder, Clear Creek, Douglas, Eagle, El Paso, Gilpin and Summit counties on decayed spruce in summer.

Enteridium olivaceum Ehrenb., Fahrb. Gewächsk. 1(2):57. 1819.
Reported from Colorado by Sturgis in 1907, p. 37 (31) from a single collection made by Bethel in El Paso County in June, 1901. Three other collections of Bethel's dated 1902, county unknown, are in BPI.

Enteridium splendens (Morgan) Macbr., N. Am. Slime-Moulds 151. 1899.
Reported from Colorado by Sturgis in 1907, p. 37 (31) as *"Enteridium Rozeanum* Wing." from collections made in Boulder and Custer counties.

Enteridium splendens (Morgan) Macbr. var. jurana (Meyl.) Härk., Karstenia 19:5. 1979. (Note. This taxon antedates the same combination by Farr, Nova Hedwigia 31(1/2). 1979).

New Colorado record.

Clear Creek Co.: On decayed conifer wood, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, August 7, 1976, *7067;* Chicago Creek (11 km southwest of Idaho Springs on Colo. 103) 2,400 m, August 8, 1976, *6874, 6875;* August 19, 1976, *7153.*

Summit Co.: On decayed spruce wood, Spring Creek (26 km southwest of Kremmling on Colo. 9) 2,800 m, October 4, 1975, *6374.*

Lycogala epidendrum (L.) Fries, Syst. Myc. 3:80. 1829.
Reported from Colorado by Macbride in 1899, p. 175 (26).

Collected in Boulder, Clear Creek, Eagle, Gilpin, Grand, Gunnison, Huerfano, Ouray, Park, Pitkin and Summit counties on decayed conifer logs associated with moss and lichen from spring to fall.

Lycogala flavofuscum (Ehrenb.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28: 68. 1873.
Reported from Colorado by Sturgis in 1907, p. 42 (31) from Boulder and Denver counties.

Tubifera ferruginosa (Batsch) J. F. Gmel., Syst. Nat. 2:1472. 1791.
Reported from Colorado by Sturgis in 1907, p. 36 (31) as *Tubulina Cylindrica* (Bull.) Rost. from collections made in Douglas, El Paso and Gilpin counties.

Collected also in Boulder, Clear Creek, Eagle and Summit counties on decayed spruce wood, covered with moss and lichen, in summer.

ORDER ECHINOSTELIALES

Echinostelium elachiston Alexop., Mycologia 50:52. 1958.

Reported from Colorado by Martin & Alexopoulos in 1969, p. 98 (30).

A collection numbered UTMC-*1346* from Boulder County, Colorado, collected by Wilson Stewart from moist chamber fruiting on the bark of *Ulmus*, cultured and determined by C.J. Alexopoulos, is in BPI.

ORDER TRICHIALES

FAMILY DIANEMACEAE

Calomyxa metallica (Berk.) Nieuwl., Am. Midl. Nat. 4:335. 1916.

Reported from Colorado by Hagelstein in 1944, p. 266 (12) as *Margarita metallica* (Berk.) A. Lister.

Collected in Boulder, Douglas and Jefferson counties on bark of living cottonwood and juniper in moist chamber.

Dianema corticatum A. Lister, Mycet. 205. 1894.

Reported from Colorado by Lister in 1925, p. 256 (23).

Collected in Eagle County on dead conifer wood from spring to fall.

Dianema depressum (A. Lister) A. Lister, Mycet. 204. 1894.

Reported from Colorado by Hagelstein in 1944, p. 269 (12), with the comment that there were only three reported collections from North America. The Colorado material was not seen by him.

Collected in Clear Creek, Eagle and Gilpin counties on decayed conifer wood from spring to fall, and in Denver County on bark of living cottonwood in moist chamber.

Dianema harveyi Rex, Proc. Acad. Phila. 43:397. 1891.

Reported from Colorado by Lister in 1925, p. 253 (23) from a collection made by Sturgis in August; previously collected in Britain as a winter species.

Collected in Jefferson County on bark of living juniper in moist chamber.

Dianema subretisporum Kowalski, Mycologia 59: 1080. 1967.

New Colorado record.

Eagle Co.: On decaying grass stems, twigs and thistle near melting snow, West Lake Creek (9.5 km south of I-70) 2,800 m, May 19, 1978, *8657, 8660* (determination by D. T. Kowalski).

FAMILY TRICHIACEAE

Arcyodes incarnata (Alb. & Schw.) O. F. Cook, Science 15:651. 1902.

Reported from Colorado by Hagelstein in 1944, p. 259 (12) as *Lachnobolus congestus* (Somm.) Lister.

Collected in Clear Creek, Eagle, Gilpin, Jefferson and Summit counties on decayed wood from spring to fall.

Arcyria cinerea (Bull.) Pers., Syn. Fung. 184. 1801.

Reported from Colorado by Sturgis in 1907, p. 40 (31) from Boulder and El Paso counties.

Collected also in Clear Creek, Eagle, Gilpin, Huerfano and Summit counties on decaying wood and forest debris from spring to fall, and in moist chamber.

Observations: Eighty percent of our collections are the pale gray, cylindric to ovoid form. Twenty percent are ochraceous. Without any relation to color or shape of sporangia, most of our collections have larger spores than the 6-7 µm range described for this species. The most common spore size is 7.5-9 µm, but in over half of our collections there are spores up to 9.5 µm in diameter. In addition to the variations in the capillitium and its ornamentation described by Martin and Alexopoulos (30), some of our collections (*4684, 6058, 6993* and *7752*) have large balloon-like swellings of the capillitial threads to twice their usual diameter, as reported by Farr (8).

Arcyria denudata (L.) Wettst., Verh. Zool.-Bot. Ges. Wien 35: Abh. 535. 1886.

Reported from Colorado by Macbride in 1899, p. 196 (26) and by Sturgis in 1907, p. 40 (31) as *A. punicea* Pers. from scanty material from El Paso and San Juan counties.

Collected also in Boulder and Huerfano counties, exsiccati in COLO.

Arcyria ferruginea Sauter, Flora 24:316. 1841.

Reported from Colorado by Sturgis in 1913, p. 451 (32) from one small collection made on charred wood in El Paso County, August, 1912.

Collected also in Boulder County, exsiccati in COLO.

Arcyria globosa Schw., Schr. Nat. Ges. Leipzig 1:64. 1822.

New Colorado record.

Clear Creek Co.: On decayed blue spruce, Squaw Pass (20 km west on Colo. 103 from Bergen Park junction with U.S. 73) 3,100 m, August 3, 1974, *4696*.

Eagle Co.: On decayed spruce, West Lake Creek (14.5 km south of I-70) 2,900 m, July 21, 1973, *3927*; (9.5 km south of I-70) 2,800 m, July 29, 1973, *3944*.

Pitkin Co.: On decayed spruce, Independence Pass (16 km southwest of Aspen on U.S. 82) 3,200 m, July 28, 1976, *6942*.

Summit Co.: On decayed wood, Spring Creek (26 km southwest of Kremmling on Colo. 9) 2,800 m, July 29, 1973, *3841-A*.

Observations: To our knowledge, this is the first listing of this species from Colorado and the first time it has been found on spruce, further attesting to the capability of this species to adapt to new substrates, following the disappearance of the American chestnut.

Arcyria incarnata (Pers.) Pers., Obs. Myc. 1:58. 1796.

Reported from Colorado by Sturgis in 1907, p. 40 (31) from Boulder, El Paso and Gilpin counties.

Collected also in Clear Creek, Eagle, Grand, Park and Summit counties from early spring to late fall on forest litter and decayed wood, both conifer and angiosperm.

Observations: There are two distinct color variants in our material. The most common is deep reddish-orange #36 before opening and the spore-covered capillitium when expanded is strong reddish-brown #40. The other, occurring only half as frequently, has a dark pink

#6 peridium, and the expanded capillitium and spores are dark yellow-pink #30.

Arcyria insignis Kalchbr. & Cooke, in Kalchbr., Grevillea 10:143.
Described by Martin and Alexopoulos, p. 130 (30) as being cosmopolitan, but not specifically reported from Colorado.

Boulder Co.: On dead wood, 7.3 km south of Nederland, 2,600 m, in moist chamber, 1958, COLO *M-146*.

Jefferson Co.: On bark of living cottonwood, W. Colfax and Cole Rd., 1,600 m, in moist chamber, 1978, *9293*.

Arcyria nutans (Bull.) Grev., Fl. Edin. 455. 1824.
Reported from Colorado by Sturgis in 1907, p. 41 (31) from Boulder, Douglas, El Paso, Gilpin, Ouray and San Juan counties on pine logs.

Collected also in Clear Creek, Custer, Eagle and Huerfano counties, usually on decaying spruce wood in summer.

Observations: Sturgis called this the most common and most striking species of *Arcyria* in Colorado. We find it to be much less common than *A. incarnata* and certainly less common and striking than *A. versicolor*. Our specimens are more robust than fruitings from the eastern United States, have a more open capillitial net, and have larger spores that reach 9-10 µm in diameter rather than the 7-8 µm usually described. The stalks are filled with spore-like cells that reach 15-20 µm in diameter. The hypothallus, confluent between sporangia, is variably rough and veined or smooth, glistening, and translucent in some shade of cream, tan or brown.

Arcyria oerstedtii Rost., Mon. 278. 1875.
Reported from Colorado by Kauffman in 1921 (13) from collections made on conifer logs, Gilpin County, 1920.

Collected also in Eagle and Summit counties on decayed wood, moss and forest litter in summer and fall.

Arcyria olivaceoglobosa Farr, Chapman & Mitchel, in Farr (in press, Nova Hedwigia).
Type collection.

Clear Creek Co.: On decayed wood, Chicago Creek (11 km southwest of Idaho Springs on Colo. 103) 2,500 m, August 3, 1974, *5431*.

Arcyria pomiformis (Leers) Rost., Mon. 271. 1875.
Reported from Colorado by Sturgis in 1907, p. 40 (31) from Boulder, Denver, Douglas, El Paso and Ouray counties.

Collected also in Clear Creek, Eagle and Larimer counties in summer and early fall.

Arcyria stipata (Schw.) A. Lister, Mycet. 189. 1894.
Reported from Colorado by Sturgis in 1907, p. 41 (31) from a single collection made by Bethel in 1902.

Collected in Eagle and Gilpin counties on dead wood in spring and fall.

Arcyria versicolor Phill., Grevillea 5:115. 1877.
Reported from Colorado by Sturgis in 1907, p. 41 (31) as *A. vitellina* Phill. from collections made in Gilpin, Grand and San Juan counties.

Collected also in Archuleta, Boulder, Clear Creek, Eagle, Gunnison, Mineral and Summit counties on dead conifer wood from early spring to late fall.

Observations: This montane species is the most abundant *Arcyria* in the Colorado Rockies. Fruitings often exceed 20 cm in diameter and may completely cover the lower surface of decayed spruce logs or completely encircle a rotten spruce stump. The color may vary in one collection from dull red through many shades of greenish-yellow, yellow, gold and orange. Other collections are uniformly brilliant canary yellow. Color is the only variable character. The plasmodium, not described in most texts, is white at first, changes to salmon-egg red to coral pink and finally yellow before fruiting.

Hemitrichia abietina (Wigand) G. Lister, Mycet. ed. 2. 227. 1911.

Reported from Colorado by Sturgis in 1907, p. 39 (31) as *H. ovata* (Pers.) Macbr. from collections made in Douglas, El Paso, Gilpin, and Ouray counties.

Collected also in Boulder, Custer and Larimer counties, exsiccati in BPI and COLO.

Hemitrichia calyculata (Speg.) Farr, Mycologia 66:887. 1974.

Described by Martin and Alexopoulos, p. 148 (30) (as *H. stipitata)* as being worldwide in distribution, but not specifically reported from Colorado.

Boulder Co.: Bethel, September, 1906, exsiccati in BPI.

Eagle Co.: On moss-covered decayed conifer wood, West Lake Creek (9 km south of I-70) 2,800 m, August 31, 1974, *5321*.

Hemitrichia clavata (Pers.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28:75.1873.

Reported from Colorado by Macbride in 1899, p. 207 (26).

Collected in Clear Creek, Eagle and Summit counties on moss, litter and decayed conifer and angiosperm wood from early spring to late fall.

Observations: This is the most common *Hemitrichia* in Colorado and shows a great deal of variation in the capillitium: elasticity, slight to marked; width, 4.5-8 µm; ornamentation, 4 to 8 minutely pilose to smooth spirals; color, yellow (concolorous with spores) to ochraceous and reddish-brown. The spore size, as in many montane collections of other species, is somewhat larger than in the text description (7-9 µm), reaching 11 µm in some fruitings.

Hemitrichia karstenii (Rost.) A. Lister, Mycet. 178. 1894.

Reported from Colorado by Sturgis in 1913, p. 451 (32) from collections made in Custer and Gilpin counties in August 1911 and 1912 on the bark of *Populus*.

Collected also in Eagle County on decayed aspen bark in the spring.

Hemitrichia montana (Morgan) Macbr., N. Am. Slime-Moulds 208. 1899.

Reported from Colorado by Martin and Alexopoulos in 1969, p. 152 (30).

Collected in Boulder, Clear Creek, Eagle, Grand and Summit counties from spring to fall on dead wood.

Hemitrichia serpula (Scop.) Rost., in Lister, Mycet. 179. 1894.

Reported from Colorado by Sturgis in 1913, p. 451 (32) from collections made in Custer County in August 1911.

Metatrichia vesparium (Batsch) Nann.-Brem., K. Ned. Akad. Wet. Proc. C. 69:346. 1966.

Reported from Colorado by Sturgis in 1913, p. 450 (32) as *Hemitrichia vesparium* (Batsch) Macbr. from a single collection made in Custer County in September, 1912.

Collected also in Eagle County in spring and fall on moss-covered decayed aspen wood.

Observations: All our 16 collections have been taken from one and the same aspen log over a period of 2 years. The fruitings are typical in every respect except that they have spines on the capillitium up to 7 μm long, which is over 3 times the length of that described for the species or that found on material we have examined from North Carolina. This is almost twice the length described for the spines of *M. horrida* Ing.

Oligonema fulvum Morgan, Jour. Cinc. Soc. Nat. Hist. 16:36. 1893.

Reported from Colorado by Martin and Alexopoulos in 1969, p. 119 (30) who, however, questioned the determination of the single Colorado specimen they had examined.

Boulder Co.: On decayed wood, 4 km southwest of Boulder, 1,900 m, May 23, 1958, COLO *M-149*.

Summit Co.: On decayed spruce bark, grass, leaves, and herbaceous stems, Spring Creek (26 km southwest of Kremmling on Colo. 9) 2,800 m, May 26, 1973, *3665*.

Oligonema schweinitzii (Berk.) Martin, Mycologia 39:460, 1947.

New Colorado record.

Gilpin Co.: On decayed aspen wood, Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, August 5, 1978, *9023*.

Perichaena chrysosperma (Currey) A. Lister, Mycet. 196. 1894.

Described by Martin and Alexopoulos, p. 110 (30) as being cosmopolitan, but not specifically reported from Colorado.

Arapahoe Co.: On bark of dead cottonwood stump, High Line Canal and So. University Blvd., 1,620 m, in moist chamber, 1978, *8513*.

Douglas Co.: On bark of living cottonwood, Larkspur junction on I-25, 1,650 m, in moist chamber, 1978, *8534*.

Jefferson Co.: On bark of living juniper, Mt. Olivet Cemetery, 1,640 m, in moist chamber, 1978, *8544*.

Perichaena corticalis (Batsch) Rost., Man. 293. 1875.

Reported from Colorado by Sturgis in 1907, p. 42 (31) from collections made in Denver and El Paso counties on cottonwood and willows.

Collected also in Boulder, Chaffee, Clear Creek, Douglas, Eagle, Gilpin, Park, San Juan and Summit counties from early spring to late fall on the inner bark of decaying aspen.

Observations: This is one of the most common slime molds in the mountainous areas of Colorado. Large fruitings can be found on aspen logs protruding from snowbanks as early as March and whenever moisture conditions permit, throughout the summer and fall. It is so common that we collect only unusual fruitings, and we have frequently observed the species fruiting in counties other than those cited. We have found it only on aspen wood, and only on the strands of inner bark.

Perichaena depressa Libert, Pl. Crypt. 378. 1837.

Reported from Colorado by Sturgis in 1907, p. 41 (31) as occurring commonly on the bark of cottonwood and willows in Boulder, Denver and El Paso counties.

Collected also in Arapahoe, Delta, Jefferson, Ouray and Park counties from moist chamber fruitings on bark of alder, juniper and cottonwood, oak leaves, grape stems and yucca.

Observations: The areas in which Sturgis collected this species are now part of the Boulder-Denver-Colorado Springs urban sprawl and most of the remaining trees are inaccessible for collecting. Since we had not found *P. depressa* in over 10 years of collecting, we assumed it had disappeared. However, when we started collecting bark from native trees still remaining in parks and cemeteries and kept it in moist chambers, *P. depressa* fruited profusely.

Perichaena vermicularis (Schw.) Rost., Mon. App. 34. 1876.

Reported from Colorado by Sturgis in 1913, p. 451 (32) from collections made in El Paso County near Colorado Springs.

Collected also in Denver County by Bethel in 1897 (exsiccati in BPI) and in Archuleta, Clear Creek and San Miguel counties from bark of cottonwood in moist chamber.

Prototrichia metallica (Berk.) Massee, Jour. Roy. Micr. Soc. 1899:350. 1889.

Reported from Colorado by Macbride in 1899, p. 200 (26) as *P. flagellifera* (Berk. & Br.) Rost. from collections made in Gilpin and Grand counties.

Collected also in Boulder, Clear Creek, Eagle, Larimer, Mineral, Ouray and Summit counties on dead conifer and aspen wood from early spring through late fall.

Observations: The description of this species given by Martin and Alexopoulos, p. 145 (30) takes in the gamut of variations we have seen in this common montane slime mold. Our material is easily separated into three forms as follows:

The most abundant form occurs in large fruitings in the early spring near melting snowbanks. The sporangia are robust (to 2.5 mm), coppery rose-brown with pink and gold iridescence. The capillitium is dark red-brown, much darker than the spores. Microscopically the capillitium consists of uniform bundles of spirally-wound rope-like threads (hollow, as demonstrated by Kowalski [16]) which fray at the penicillate ends into smaller and smaller strands tapering to fine tips attached to the peridium. Only rarely are amorphous strands seen.

Fruiting at the same time, on the same substrates, but never intermingled with the coppery forms, are slightly smaller (to 1.7 mm) sporangia that are tobacco brown with peridial highlights of blue and gold. Grossly, the capillitium is a drab umber brown that is much lighter than the spore mass. Microscopically, the capillitium varies from simple smooth threads, often with funnel tips, to amorphous sheets, and rarely to penicillate, spiral ropes with single to multiple pointed tips.

In late summer and fall, small fruitings of small (to 1.3 mm) red-orange sporangia with gold, rose and blue iridescence occur. In these fruitings, as in the coppery form, the capillitium is dark red-brown, darker than the spore mass, and composed entirely of the uniform rope-like, spirally-wound threads with penicillate ends and slender tapering tips, without any amorphous strands.

Variations in color and capillitial characteristics may prove to be nothing more than developmental features produced by dry weather and/or cold temperatures as suggested by Lister in 1925, p. 257 (23). We have been unable to demonstrate constant differences that would justify varietal names other than mere color designations. The sporangia are sessile on a constricted base with only an occasional sporangium being short-stalked. They are seated on a confluent hypothallus that is completely colorless in most collections, but occasionally varies to amber tints in the copper-colored fruitings. The spores fall within the range of measurements described in most texts (10-15 μm), are spinulose, and in a few collections of the brown form have an olivaceous tinge to the usual pale yellow color.

Trichia alpina (R. E. Fries) Meylan, Bull. Soc. Vaud. Sci. Nat. 53:460. 1921.

New Colorado record.

Clear Creek Co.: On decayed wood, Squaw Pass (6.5 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,600 m, June 12, 1974, *4294*; July 24, 1974, *4665*.

Eagle Co.: On herbaceous stems near melting snow, West Lake Creek (9 km south of I-70) 2,800 m, May 15, 1976, *6570*.

Gilpin Co.: On herbaceous stems, Perigo (13 km north of Black Hawk on Colo. 119) 2,900 m, August 7, 1976, *6846*.

Summit Co.: On decayed wood near melting snow, Mayhan Lake Road (16 km southwest of Heeney) 3,100 m, July 13, 1975, *5762*.

Observations: Our material varies somewhat from the descriptions of Martin and Alexopoulos, p. 55 (30) in that the hypothallus is an extensive, confluent, translucent, yellow-brown #66 sheet, rather than "very delicate", and the spore size varies from 12-14 μm in one collection (*5762*) to 17-19 μm in another (*8004*). Spores of the other collections fit the 14-18 μm range described.

Trichia botrytis (J. F. Gmel.) Pers., Neues Mag. Bot. 1:89. 1794.

Reported from Colorado by Sturgis in 1907, p. 39 (31) from a single collection made in El Paso County in 1906.

Collected also in Boulder, Clear Creek, Custer, Eagle, Gilpin, Gunnison and Routt counties on decorticate wood in spring and summer.

Observations: Our collections agree with the text descriptions except that the spore size in three otherwise identical collections was 10-11 μm, 12-14 μm and 13-16 μm, respectively (instead of 9-11 μm). The last two of these size ranges even exceed that given by Kowalski (21) for *T. flavicoma*.

Trichia contorta (Ditmar) Rost.,Mon. 259. 1875.

Reported from Colorado by Sturgis in 1907, p. 38 (31) (as *T. contorta* var. *inconspicua* Rost.) as common on the inner bark of box elder throughout the State, specifically from Boulder, Denver, El Paso, Larimer and Ouray counties. In 1913, p. 450 (32) he reported it from Gilpin County on the inner bark of *Populus*.

Collected also in Clear Creek, Douglas, Eagle, Huerfano, Jefferson, Mesa and Summit counties, on decayed wood, particularly the inner bark of aspen, from early spring to late fall.

Observations: We have found this to be as plentiful as, and often associated with, *Perichaena corticalis* (Batsch) Rost. Our material shows a black hypothallus rather than white as described by Martin and Alexopoulos, p. 157 (30). Our collection *7602* fits the description of *T. contorta* var. *attenuata* Meylan.

Trichia decipiens (Pers.) Macbr., N. Am. Slime-Moulds 218. 1899.

First reported from Colorado by Sturgis in 1907, p. 38 (31) as *T. fallax* Pers. from collections in El Paso, Gilpin and Summit counties.

Collected also in Clear Creek, Eagle and Grand counties on dead wood from early spring to late fall and in moist chamber.

Observations: This common species occurs in two distinct color forms: olive and orange-yellow. Each color is homogeneous throughout (peridium, stalk, capillitium and spores), without intergradation, and we agree with Kowalski (22) that there are two distinct varieties. Sixty percent of our collections are var. *olivacea* Meylan and forty percent are var. *decipiens*.

Trichia favoginea (Batsch) Pers., Neues Mag. Bot. 1:90. 1794.

Reported from Colorado by Sturgis in 1907, p. 37 (31) as *T. persimilis* Karst., and p. 38 as *T. affinis* DBy. from collections in Douglas, El Paso, Ouray and San Juan counties.

Collected also in Boulder, Clear Creek, Eagle, Fremont, Gilpin, Grand, Park, Pitkin and Summit counties on rotting wood, conifer duff and soil, often associated with moss, through summer and fall.

Trichia floriformis (Schw.) G. Lister, Jour. Bot. 57:110. 1919.

Described by Martin and Alexopoulos, p. 161 (30) as being widely distributed, but not specifically reported from Colorado.

Clear Creek Co.: On decayed conifer wood, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, October 25, 1976, *7574*.

Eagle Co.: On decayed conifer wood, West Lake Creek (9 km south of I-70) 2,800 m, September 10, 1976, *7283*.

Observations: Our material is of the western robust variety described by Martin and Alexopoulos, p. 161 (30), attaining 2 mm in height, displaying a deep infundibuliform calyculus with a petaloid margin. The hypothallus varies from blackish-red to almost colorless, and the spores and capillitium are golden to brownish-orange, but never "brick red".

Trichia lutescens (A. Lister) A. Lister, Jour. Bot. 35:216. 1897.

Reported from Colorado by Macbride and Martin in 1934, p. 285 (28) as the first American record.

Collected in Boulder, Clear Creek, Eagle and Larimer counties on dead wood in summer.

Trichia scabra Rost., Mon. 258. 1875.

Described by Martin and Alexopoulos, p. 163 (30) as cosmopolitan, but not specifically reported from Colorado.

Eagle Co.: On decayed aspen wood, West Lake Creek (11 km south of I-70) 2,900 m, October 31, 1976, *7610, 7657;* May 22, 1977, *7784, 7792*.

Gilpin Co.: On decayed aspen, Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, July 16, 1977, *7836*.

Trichia subfusca Rex, Proc. Acad. Phila. 42:192. 1890.

Described by Martin and Alexopoulos, p. 164 (30) as widespread, but not specifically reported from Colorado.

Clear Creek Co.: On decayed wood at edge of melting snowbanks, Squaw Pass (6.5 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,600 m, May 15, 1974, *4217;* June 26, 1974, *4628.*

Gilpin Co.: On decayed wood at edge of melting snowbank at Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, June 22, 1974, *4618.*

Summit Co.: On decayed wood at edge of melting snowbank on Spring Creek (28 km southwest of Kremmling on Colo. 9) 2,900 m, May 23, 1971, *3020;* May 22, 1976, *6605.*

Trichia varia (Pers.) Pers., Neues Mag. Bot. 1:90. 1794.

Reported from Colorado by Sturgis in 1907, p. 39 (31) as "common everywhere" from collections made in Boulder, Denver and Ouray counties.

Collected also in Clear Creek, Eagle, Gilpin, Larimer and Summit counties, on dead wood, from early spring to late fall.

ORDER PHYSARALES

FAMILY DIDYMIACEAE

Diachea leucopodia (Bull.) Rost., Mon. 190. 1874.

Reported from Colorado by Sturgis in 1907, p. 26 (31) from collections on dead leaves in Boulder County.

Diachea subsessilis Peck, Ann. Rep. N.Y. State Mus. 31:41. 1879.

Reported from Colorado by Sturgis in 1913, p. 445-446 (32) from collections in Custer, El Paso and Gilpin counties.

Diderma asteroides (A.& G. Lister) G. Lister, in Lister, Mycet. ed. 2. 113. 1911.

Reported from Colorado by Sturgis in 1913, p. 445 (32) from a collection made in El Paso County in September, 1908. This was the first recorded occurrence in North America.

Collected also in Boulder, Clear Creek and Larimer counties on dead wood and bark from early spring to late fall.

Diderma brooksii Kowalski, Mycologia 60(3): 595-603. 1968.

New Colorado record.

Summit Co.: On decorticate spruce in melting snow, Spring Creek (26 km southwest of Kremmling on Colo. 9) 2,800 m, May 13, 1978, *8596* (confirmed by D. T. Kowalski), *8620;* June 6, 1978, *8783.*

Observations: This species appears to be intermediate between *Diderma* and *Physarum.* The general aspect and the coarse, dark capillitium are certainly *Diderma*-like, but the latter, in the Colorado material, contains fairly abundant lime nodes in the lower portion of the sporangia, and there are only vestigial traces of limy columellae, such as found in the type specimen of *D. brooksii.* Although the capillitium suggests that of *D. evelinae* (Meylan) Kow., it is also similar to brown portions of capillitium we have observed in some collections of *Physarum albescens* Ellis ex Macbr. (which see). In these collections, the fruiting bodies are elongated and the limy nodes may be aggregated into pseudocolumellae. Further evidence may well necessitate the transfer of *D. brooksii* to *Physarum*.

Diderma chondrioderma (de Bary & Rost.) G. Lister, in Lister, Mycet., ed. 3. 258. 1925.

Reported from Colorado by Martin and Alexopoulos in 1969, p. 353 (30).

Diderma cor-rubrum Macbr., N. Am. Slime-Moulds ed. 2. 140. 1922.

Reported from Colorado by Martin and Alexopoulos in 1969, p. 354 (30).

Diderma crustaceum Peck, Ann. Rep. N.Y. State Mus. 26:74. 1874.

Reported from Colorado by Sturgis in 1907, p. 26 (31) quoting Macbride's manuscript, but not previously verified from Colorado.

Eagle Co.: On decayed bark of elder near melting snow, West Lake Creek (9 km south of I-70) 2,800 m, June 6, 1976, *6755*.

Diderma effusum (Schw.) Morgan, Jour. Cinc. Soc. Nat. Hist. 16:155. 1894.

Reported from Colorado by Sturgis in 1913, p. 445 (32) from a single collection made in Custer County in August, 1911.

Collected also in Gilpin County, exsiccati COLO *M-548*.

Diderma floriforme (Bull.) Pers., Neues Mag. Bot. 1:89. 1794.

Described by Martin and Alexopoulos, p. 358 (30) as being widely distributed in north temperate regions, but not specifically reported from Colorado.

Clear Creek Co.: On decaying wood, Chicago Creek (11 km southwest of Idaho Springs on Colo. 103) 2,700 m, August 28, 1976, *7193*.

Gilpin Co.: On decaying wood, Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, September 17, 1978, *9046*.

Diderma globosum Pers., Neues Mag. Bot. 1:89. 1794.

Reported from Colorado by Sturgis in 1907, p. 26 (31) from a collection made by Bethel in Boulder County, exsiccati in BPI.

Collected also in Clear Creek, Custer, El Paso and Larimer counties, exsiccati in BPI.

Diderma hemisphaericum (Bull.) Hornem., Fl. Dan. 33:13. 1829.

Reported from Colorado by Sturgis in 1907, p. 25 (31) as *D. michelii* (Lib.) Corda, from a single collection made by Bethel in Aurora, Arapahoe County, in August 1906.

Diderma lyallii (Massee) Macbr., N. Am. Slime-Moulds 99. 1899.

Reported from Colorado by Martin and Alexopoulos in 1969, p. 362 (30).

Collected in Boulder, Clear Creek, Eagle, Larimer, Mineral and Summit counties on plant litter at the edge of melting snow in early spring at 2,800 - 3,000 m.

Observations: This is the most abundant snowbank *Diderma* in Colorado; it is also one of the most variable. In addition to the variations in spore ornamentation described in standard texts, many other variations occur. The sporangia, usually subglobose or obovate, may be pulvinate (*5550*), pendent (*5578, 5579, 5580*) or so strikingly clavate (*4358, 4375*) as to suggest a distinct variety. The peridium, usually double, may have the thick outer layer so densely encrusted with limy scales as to form a third layer. Occasionally the middle and/or outer layer contains coarse patches of crystalline lime in the form of rosettes or rectangles (*2409*) as in *D. trevelyani* or *Lepidoderma*. The peridium may vary in color from stark white to cream or buff and is often mottled (*4275*) or areolate (*5583*) over the apex. The columella varies almost directly in size and almost inversely in depth of color with the amount of lime it contains. In limy fruitings it is prominent, white, clavate, reaching the center of the sporangium. When lime is scanty (*4328, 4334, 4336, 4362, 6817*) or lacking (*3389, 3390*) the columella appears as a small, shrivelled, brown to black thread. The capillitium varies from purplish brown to hyaline and from smooth to rough or beaded.

Diderma montanum (Meylan) Meylan, Ann. Cons. Jard. Genève 16:311. 1913.

Reported from Colorado by Macbride and Martin in 1934, p. 132 (28).

Collected in Clear Creek, Eagle, Gilpin, Mineral, Park and Summit counties on plant litter, leaves and mosses from early spring to late fall.

Observations: This species, described as being widely scattered but "not common" in the north temperate regions (30), is very common in the Colorado Rocky Mountains. It is also more variable than generally described. As in many other species, our montane collections have spores exceeding the 8-10 µm range described in the texts, with diameters reaching 13.5 µm. Spore ornamentation varies from minutely spinulose to prominently spinulose with incomplete reticulation. In many collections (*3825, 4845, 5322, 6064, 6328, 6352, 6372, 6373, 6375*) the lime in the outer layer of the peridium is porcelainized.

Diderma niveum (Rost.) Macbr., N. Am. Slime-Moulds 100. 1899.

Reported from Colorado by Sturgis in 1907, p. 26 (31) from a single collection made by Bethel in 1902.

Collected in Boulder, Clear Creek, Douglas, Eagle, Gunnison, Larimer and Summit counties on decayed wood, herbaceous stems, granite pebbles and litter under mixed woods near melting snowbanks in spring and on decayed wood in summer.

Observations: We originally tried to separate our material into *Diderma alpinum* Meylan and *D. niveum*, but we found, as observed by Kowalski (22), that *D. alpinum* is much more variable than described by previous authors. The color of the peridium, usually pure white, may be a sordid, pinkish Isabelline or drab, grayish-white. The columella, usually prominent though pulvinate, may in some plasmodiocarps be merely an inconspicuous ridge at the base and may vary from ochraceous-orange or fawn to ivory or even pure white. The pigment when present appears to be confined to the base of the inner layer of the peridium and this, like the capillitium, may vary from hyaline to pigmented. The spores range in size from 10.5-15.0 (-17.0) µm; some are evenly spinulose while others have clusters of larger, darker spines separated by lighter bands. Some fruitings (*4230, 4234, 4235, 7525*) are nearly limeless, in some (*4263, 5509*) the lime in the outer layer of the peridium is porcelainized; and some (*6746, 6751*) display crystalline lime in the base. These variations appear to be unrelated and do not warrant segregation into varieties or species.

We had assigned over 70 collections to *D. alpinum* mainly because they fruited in the early spring near melting snow, and only one (*6329*), which was found on decayed wood in summer, to *D. niveum*. Three collections (*3667*, *3690*, *4617*) we could not confidently place in either species. We agree with Farr (11) that the two species are conspecific.

Diderma radiatum (L.) Morgan, Jour. Cinc. Soc. Nat. Hist. 16:151. 1894.
Reported from Colorado by Sturgis in 1907, p. 24 (31) as *D. stellare* (Schrad.) Pers. from Boulder, El Paso and Gilpin counties on decayed cottonwood.
Collected also in Chaffee, Clear Creek, Custer, Eagle and Larimer counties in spring and fall on decayed wood.

Diderma roanense (Rex) Macbr., N. Am. Slime-Moulds 104. 1899.
Reported from Colorado by Lister in 1925, p. 97 (23).
Collected in Eagle County on decayed wood in summer.

Diderma sauteri (Rost.) Macbr., N. Am. Slime-Moulds 103. 1899.
Reported from Colorado by Sturgis in 1907, p. 26 (31), quoting Macbride's manuscript, but not found by Sturgis or by us and there are no Colorado collections in BPI, COLO, or RM.

Diderma spumarioides (Fries) Fries, Syst. Myc. 3:104. 1829.
Reported from Colorado by Sturgis in 1907, p. 24 (31) from Boulder, El Paso and San Juan counties.
Collected also in Archuleta, Clear Creek, Custer and Gilpin counties on forest litter in summer.

Diderma testaceum (Schrad.) Pers., Syn. Fung. 167. 1801.
Reported from Colorado somewhat uncertainly by Sturgis in 1907, p. 25 (31) from a single small collection made in El Paso County in September, 1906.
Collected also in Gilpin County, exsiccati in COLO.

Diderma trevelyani (Grev.) Fries, Syst. Myc. 3:105. 1829.
Reported from Colorado by Sturgis in 1907, p. 25 (31) from collections made by Bethel in Boulder and Jefferson counties.
Collected also in Chaffee, Clear Creek, Custer, Eagle, Gilpin, San Juan and Summit counties on decayed wood, both aspen and conifer; dead leaves; and living and dead herbaceous stems in spring and summer.

Didymium anellus Morgan, Jour. Cinc. Soc. Nat. Hist. 16:148. 1894.
Reported from Colorado by Sturgis in 1907, p. 27 (31) from a collection made by Bethel on dead leaves in Boulder County in September, 1906.
Collected also in Clear Creek and El Paso counties on inner bark of decayed cottonwood and aspen logs in summer, and in Delta County on bark of living juniper in moist chamber.

Didymium clavus (Alb. & Schw.) Rab., Deuts. Krypt.-Fl. 1:280. 1844.
Reported from Colorado by Sturgis in 1913, p. 447 (32) from Archuleta County on bark of fir in August, 1911.
Collected also in Custer, Eagle, El Paso and Larimer counties on bark of fir and on leaves and bark of aspen in summer.

Didymium crustaceum Fries, Syst. Myc. 3:124. 1829.

Reported from Colorado by Sturgis in 1913, p. 445 (32) from Custer, El Paso and Gilpin counties.

Collected also in Eagle and Summit counties on decayed wood, leaves and twigs in summer.

Didymium decipiens Meylan, Bull. Soc. Vaud. Sci. Nat. 58:319. 1935.

New hemisphere record.

Clear Creek Co.: On dead twigs of shrubs near melting snowbank, Squaw Pass (18 km west on Colo. 103 from Bergen Park junction with U.S. 73) 3,200 m, June 15, 1975, *5599*.

Observations: To our knowledge this is the first time this species has been found outside the Swiss Alps. The large coarsely warted spores and the light brownish (or pinkish) yellow capillitial threads twisted and spiralled and wrapped around other strands are characteristic. These resemble the capillitium of *Prototrichia metallica* (Berk.) Massee.

Didymium difforme (Pers.) S. F. Gray, Nat. Arr. Brit. Pl. 1:571. 1821.

Reported from Colorado by Sturgis in 1907, p. 28 (31) from collections made by Bethel in Denver County on "dead leaves, twigs and bits of glass [sic]."

Collected also in Jefferson County (Golden) by Bethel, August, 1906, exsiccati in BPI.

Didymium dubium Rost., Mon. 152. 1874.

Reported from Colorado by Macbride and Martin in 1934, p. 109 (28).

Collected in Clear Creek, Douglas, Eagle, Gilpin and Summit counties on herbaceous stems, twigs, leaves and bark near melting snowbanks in early spring.

Observations: This is one of the most common *Didymium* species of the montane snowbank flora in Colorado. Like many of our montane species, it shows variations not described in the texts. The inconspicuous columella or the thickened base of the plasmodiocarps may vary in color from white to cream to light brown, the thin (1 µm) capillitial threads are beaded with dark brown nodes ± 3 µm in diameter. The hypothallus, consisting of a thin translucent sheet, extends only slightly beyond the edge of individual plasmodiocarps but when crowded becomes confluent with that of neighboring fructifications and is occasionally covered with crystalline lime. The spores, as in many other species, are on the large side of the 10-15 µm range described (mostly 12-15 µm) and vary in color and ornamentation. In most collections they are evenly colored and uniformly warted; in others (*4301*, *6768*, *6779*) they are lighter over one-third of the surface and incompletely reticulate.

Didymium fulvum Sturgis, Mycologia 9(6):327. 1917.

Type locality: Colorado.

Described from specimens collected on dead twigs, leaves and other refuse, Wet Mountain Valley, Custer County, August, 1913.

Appeared in moist chamber on yucca fronds collected in Jefferson County.

Observations: In our material (all moist chamber fruitings) the spores are 9-10 µm in diameter rather than the 12-14 µm as described for *D. fulvum* and the hypothallus is limeless and scanty rather than "lime encrusted".

Didymium megalosporum Berk. & Curt., Grevillea 2:53. 1873.
Reported from Colorado by Sturgis in 1907, p. 28 (31) as *D. eximium* Peck, from collections made in Boulder and El Paso counties.

Didymium melanospermum (Pers.) Macbr., N. Am. Slime-Moulds 88. 1899.
Reported from Colorado by Sturgis in 1907, p. 26 (31) as *D. farinaceum* Schrad. from collections made in Boulder, El Paso and Gilpin counties.

Collected also in Clear Creek, Eagle, Grand, Larimer and Summit counties on dead wood, twigs and forest litter from early spring to late fall.

Didymium minus (A. Lister) Morgan, Jour. Cinc. Soc. Nat. Hist. 16:145. 1894.
Described by Martin and Alexopoulos, p. 393 (30) as being cosmopolitan, but not specifically reported from Colorado.

Grand Co.: On decorticate Englemann spruce, south fork of Williams Fork River (56 km southeast of Parshall) 2,600 m, August 2, 1975, *5937*.

Larimer Co.: A collection made in Estes Park by E. C. Smith in 1927 is in BPI.

Didymium nigripes (Link) Fries, Syst. Myc. 3:119. 1829.
Reported from Colorado by Sturgis in 1907, p. 28 (31) from a collection made in El Paso County.

Collected also in Clear Creek County on dead wood in summer.

Didymium nivicolum Meylan, Bull. Soc. Naud. Sci. Nat. 57:40. 1929.
New Colorado record.

Clear Creek Co.: On grass, herbaceous stems and living leaves near melting snow, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, May 5, 1976, *6551*.

Eagle Co.: On grass and herbaceous stems near melting snow, West Lake Creek (8 km south of I-70) 2,600 m, May 4, 1974, *4183;* May 24, 1975, *5528;* May 25, 1975, *5548*.

Summit Co.: On grass, leaves, and herbaceous stems in melting snowbank, Summit Lake, Loveland Pass, 3,500 m, June 25, 1978, *8930*.

Observations: Our experience with this species has been similar to that of Kowalski (22), in that we had separated our collections of *D. dubium* into two, equally common, distinct varieties labeled "thick" and "thin". Upon reading Kowalski's article in 1975, we immediately realized that our "thick" variety was *D. nivicolum* and his observations accurately describe our material. Both *D. dubium* and *D. nivicolum* are common near melting snowbanks. In our collections of both species the peridium may vary from smooth (egg-shell) (*5575*, *6551*) to flaky or, when lime is scant, iridescent (see *D. quitense*).

Didymium quitense (Pat.) Torrend, Broteria 7:90. 1908.
Reported from Colorado by Sturgis in 1913, p. 446 (32) from collections made in El Paso County in August 1912.

Collected also in Eagle and Lake counties on plant debris near melting snowbanks in early spring.

Observations: Eight of our collections of *Didymium* fit the description of this species but we agree with Kowalski (19) that this is only a nearly limeless montane form of *D. dubium* with larger, darker spores and a blue iridescent inner peridium easily seen because of the sparse outer lime coating. If these variations are sufficient to warrant species designation then another species should be named to include our similar iridescent lime-deficient, large-spored collections of *D. nivicolum* (*5528, 5540*).

Didymium squamulosum (Alb. & Schw.) Fries, Symb. Gast. 19. 1818.

Reported from Colorado by Sturgis in 1907, p. 27 (31) from collections in Arapahoe, Boulder, Denver, El Paso, Gilpin and Larimer counties.

Collected also in Chaffee, Clear Creek, Eagle, Grand, Jefferson and Summit counties on decayed wood, forest litter and weasel dung in summer; in Weld County on cow and rabbit dung in moist chamber (2); and in Boulder County on yucca in moist chamber.

Observations: Many of our collections have spores 11-13 (-14) µm in diameter rather than 8-11 µm as usually described.

Didymium sturgisii Hagelst., Mycologia 29:397. 1927.

Type locality: Colorado.

First reported from Colorado by Sturgis in 1913, p. 444 (32) as *D. anomalum* Sturgis from collections made on the inner bark of *Populus*, Colorado Springs, El Paso County, July, 1911. One of these became the type collection.

Collected also in Boulder and Jefferson counties on yucca in moist chamber.

Lepidoderma carestianum (Rab.) Rost., Mon. 188. 1874.

New Colorado record.

Clear Creek Co.: On decayed wood and granite cobble, near melting snow, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, May 28, 1977, *7795*.

Eagle Co.: On charred spruce log, near melting snow, West Lake Creek (14.5 km south of I-70) 3,000 m, July 7, 1973, *3902*.

Gilpin Co.: On decayed wood near melting snow, Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, May 22, 1974, *4241*.

Grand Co.: On decayed aspen wood, near melting snow, Ute Pass (13 km northeast of Silverthorne) 2,900 m, May 26, 1975, *5708*.

Ouray Co.: On decayed conifer wood, Canyon Creek (3 km southwest of Ouray on Colo. 361) 2,400 m, August 28, 1975, *6063*.

Summit Co.: On decayed conifer wood, Mayhan Lake Road (16 km southwest of Heeney) 3,100 m, July 6, 1974, *4643*.

Observations: We have arbitrarily divided our material between *L. carestianum* and *L. chailletii* and have cited collections accordingly. However, of our thirty collections, half cannot be assigned to either species with any degree of confidence because of intergradation of all distinguishing characters. Either there is crossbreeding between these two closely related species or as Kowalski (19) suggests there is only one variable species, *L. carestianum*.

Lepidoderma chailletii Rost., Mon. 189. 1874.

New Colorado record.

Clear Creek Co.: On decayed wood, Squaw Pass (5 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,500 m, June 6, 1973, *3678*.

Eagle Co.: On decayed wood, near melting snow, West Lake Creek

(9.5 km south of I-70) 2,800 m, May 18, 1974, *4332*.

Gilpin Co.: On decayed aspen wood, Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, June 9, 1973, *3686*.

Grand Co.: On decayed conifer wood, in snowbank, Church's Park (16 km southwest of Tabernash) 3,000 m, June 17, 1978, *8833*.

Summit Co.: On grass and plant stems, near melting snow, Spring Creek (26 km southwest of Kremmling on Colo. 9) 2,800 m, May 20, 1978, *8728*.

Lepidoderma granuliferum (Phill.) R. E. Fries, Ark. Bot. 6 (7):3. 1906.

New Colorado record.

Lake Co.: On dead twigs of shrubs in snowbank, Independence Pass, 3,600 m, July 16, 1978, *8959*.

Lepidoderma tigrinum (Schrad.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28:73. 1873.

Reported from Colorado by Sturgis in 1913, p. 447 (32) from a single collection found on moss and decayed wood in spruce forest at Tolland, Gilpin County, in August, 1912.

Collected also in Clear Creek and Eagle counties on moss and decayed wood in summer.

Mucilago crustacea Wiggers, Prim. Fl. Holsat. 112. 1780.

Reported from Colorado by Sturgis in 1907, p. 29 (31) as both *Spumaria alba* Bull. and *Spumaria alba* var. *solida* Sturgis from collections made in Archuleta, Boulder, Denver and El Paso counties on dead wood and plant debris in 1906.

Reported also from Gilpin County by C. H. Kauffman in 1921 (13) as *M. spongiosus* (Ley.) Morg.

Collected also in Custer County on dead wood, and in Delta County on bark of living cottonwood in moist chamber.

FAMILY PHYSARACEAE

Badhamia affinis Rost., Mon. 143. 1874.

Reported from Colorado by Sturgis in 1907, p. 13 (31) as *B. orbiculata* Rex from a collection made by Bethel in Boulder County in September 1906, on bark of dead cottonwood.

Collected also in Denver, El Paso, Jefferson and Summit counties on decorticate wood in summer and on bark of living juniper and cottonwood in moist chamber. Collections from Custer and Larimer counties are in NYBG.

Badhamia capsulifera (Bull.) Berk., Trans. Linn. Soc. 21:153. 1853.

Reported from Colorado by Macbride and Martin in 1934, p. 29 (28).

Collected in Denver County (by Bethel in 1896 and 1907) exsiccati in BPI and in Larimer County, exsiccati in NYBG. Also appeared in moist chamber on bark of Douglas fir collected in El Paso County.

Badhamia dearnessii Hagelst., Mycologia 34:117. 1942.

New Colorado record.

Clear Creek Co.: On bark of Colorado blue spruce, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, August 7, 1976, *6956*.

Eagle Co.: On bark of dead conifer, West Lake Creek (11 km south of I-70) 2,900 m, August 28, 1976, *7370*.

Gilpin Co.: On bark of dead conifer, Perigo (13 km north of Black Hawk on Colo. 119) 2,900 m, August 8, 1976, *6981*, *7527*.

Summit Co.: On decorticate spruce log, Spring Creek (27 km southwest of Kremmling on Colo. 9) 2,850 m, July 29, 1974, *4686*.

Badhamia foliicola A. Lister, Jour. Bot. 35:209. 1897.

Described by Martin and Alexopoulos, p. 253 (30) as widespread, but not specifically reported from Colorado.

Arapahoe Co.: On bark of living cottonwood, High Line Canal and So. University Blvd., 1,620 m, in moist chamber, 1978, *8547*.

Clear Creek Co.: On dead wood, bark, herbaceous stems and living and dead leaves, Chicago Creek (11 km southwest of Idaho Springs on Colo. 103) 2,700 m, August 21, 1977, *7886*.

Eagle Co.: On dead stems of cow parsnip (*Heracleum lanatum* Michx.), West Lake Creek (14.5 km south of I-70) 2,900 m, July 27, 1974, *4536*.

Gilpin Co.: On herbaceous stems, Perigo (13 km north of Black Hawk on Colo. 119) 2,900 m, June 22, 1974, *4620*.

Summit Co.: On decayed wood, Spring Creek (28 km southwest of Kremmling on Colo. 9) 2,800 m, July 28, 1973, *3828*.

Badhamia gracilis (Macbr.) Macbr., in Macbr. & Martin, Myxom. 35. 1934.

Type locality: Leyden, Jefferson County, Colorado.

Reported from Colorado by Sturgis in 1913, p. 438 (32) as *B. macrocarpa* (Ces.) Rost. from what became the type collection made by Bethel on old yucca stems at Leyden, Jefferson County, Colorado, Jan. 25, 1910.

Collected also in Boulder and Denver counties on bark of cottonwood and grape and yucca stems in moist chamber.

Badhamia macrocarpa (Ces.) Rost., Mon. 143. 1874.

Reported from Colorado by Sturgis in 1913, p. 438 (32) from collections made in El Paso County.

Collected also in Eagle, Gilpin, Jefferson, Larimer (RM-*13254*) and Summit counties on dead wood, herbaceous stems, leaves and twigs, in spring and summer, and on bark of living cottonwood and juniper in moist chamber.

Badhamia nitens Berk., Trans. Linn. Soc. 21:153. 1853.

Reported from Colorado by Sturgis in 1907, p. 13 (31) from collections made by Bethel on the bark of *Abies concolor* (Gord. & Glend.) Hoopes in Ouray County in August 1905.

Badhamia ovispora Racib., Rozp. Akad. Umiej. 12:72. 1884.

Reported from Colorado by Hagelstein in 1944, p. 27 (12) from collections made by E. C. Smith on decayed aspen wood in Jefferson County, 1925 (NYBG *10635*) and in Larimer County, 1931 (NYBG *10632*).

Collected also by Henry Aldrich (HA *13*) on the inner bark of decaying gymnosperm, 3,100 m, Boulder County, August, 1964 (6).

Observations: These three Colorado collections are the only known examples of this species except for the single type collection made by Raciborski on *Populus* near Cracow, Poland, 1882 (14).

Badhamia panicea (Fries) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28: 71. 1873.

Reported from Colorado by Sturgis in 1907, p. 11 (31) from collections on cottonwood and box elder in Boulder, Jefferson and Larimer counties from June to September.

Collected also in Clear Creek and Summit counties on decayed aspen wood and leaves in summer, and in Delta County on bark of juniper in moist chamber. Collections from Custer and El Paso counties are in NYBG.

Observations: In some of our collections and in many collections at BPI, the spores are 9-11 µm in diameter with coarser darker spines arranged in clumps, rather than "minutely punctate, 11-14 µm in diameter" as described in the texts. G. Lister (23) reports var. *heterospora* as being "found repeatedly" in Colorado.

Badhamia populina A.& G. Lister, Jour. Bot. 42:129. 1904.

Reported from Colorado by Sturgis in 1907, p. 11 (31) from collections made by Bethel in Boulder and Denver counties on the bark of cottonwood and box elder in the summer of 1906.

Collected also in Archuleta, El Paso, Jefferson and Larimer counties, exsiccati in BPI and NYBG. Also appeared in moist chamber on bark of living angiosperm collected in Gilpin County.

Badhamia utricularis (Bull.) Berk., Trans. Linn. Soc. 21:153. 1853.

Reported from Colorado by Sturgis in 1907, p. 14 (31) from a collection made by Bethel at Tolland, Gilpin County in September 1906.

Collected also in Alamosa, Clear Creek, Custer, Eagle, El Paso, Larimer, Park, Pitkin and Summit counties on decayed bark (particularly aspen), leaves, twigs and basidiocarps of polypores from early spring to late fall.

Badhamia versicolor A. Lister, Jour. Bot. 39:81. 1901.

Reported from Colorado by Sturgis in 1907, p. 13 (31) from a collection made by Bethel on the bark of box elder in Boulder County in July, 1906. This collection, verified by Lister, was the first American collection.

Collected also in El Paso and Larimer counties, exsiccati in BPI and COLO, and in Jefferson County on bark of living cottonwood in moist chamber.

Badhamiopsis ainoae (Yama.) Brooks & Keller, Mycologia 68 (4): 834-841. 1976.

New Colorado record.

Boulder Co.: On bark of living juniper in moist chamber, Boulder Cemetery, Boulder, 1,650 m, 1978, *8595*, *8731*.

Denver Co.: On bark of living juniper in moist chamber, Fairmount Cemetery, Denver, 1,600 m, 1978, *8519*.

Jefferson Co.: On bark of living juniper in moist chamber, Mount Olivet Cemetery, 1,620 m, 1978, *8525*; 1979, *9278*.

Observations: Our collections are all from the bark of living *Juniperus virginiana* L. (the most common host for this species in America) and fit the revised description given by Brooks and Keller (15) except for the spores which they describe as "minutely verrucose, 9-11 µm diam." In all nine of our collections the spores are 12-16 µm in diameter and densely covered with dark, coarse spines 0.5-1 µm long. Although this divergence in spore characteristics in our material is apparently stable (as indicated by its repeated appearance) we have only moist chamber fruitings. In the absence of specimens developed under natural field conditions, we would hesitate to set up a new taxon at this time.

Cienkowskia reticulata (Alb. & Schw.) Rost., Mon. 91. 1874.

Reported from Colorado by Sturgis in 1907, p. 22 (31) from collections made in Boulder County in September, 1906.

Collected also in Custer, Gilpin and Larimer counties on dead aspen wood in summer.

Craterium aureum (Schum.) Rost., Mon. 124. 1874.

Reported from Colorado by Lister in 1925, p. 80 (23).

Collected in Clear Creek and El Paso counties on dead conifer wood in summer.

Craterium leucocephalum (Pers.) Ditmar, in Strum, Deuts. Fl. Pilze 1:21. 1813.

Reported from Colorado by Sturgis in 1907, p. 22 (31) from collections in Boulder, El Paso, Gilpin and Jefferson counties.

Collected also in Arapahoe, Clear Creek and Custer counties on grass, leaves, forest litter and decayed wood, both aspen and conifer, in summer and in moist chamber.

Observations: Three of our collections fit the description of var. *rufum* G. Lister, Mycet. ed. 3. 78. 1925; one fits the description of var. *cylindricum* (Massee) G. Lister, Mon. ed. 2. 97. 1911; and one var. *scyphoides* (Cke. & Balf.) G. Lister (determined by E. Nannenga-Bremekamp).

Craterium minutum (Leers) Fries, Syst. Myc. 3:151. 1829.

Reported from Colorado by Sturgis in 1907, p. 23 (31) from collections by Bethel in Boulder County in September, 1906.

Collected also in Clear Creek County on dead leaves, decayed wood and moss in summer.

Craterium obovatum Peck, Bull. Buff. Soc. Nat. Sc. 1:64. July, 1873.

Described by Martin and Alexopoulos, p. 257 (30) (as *Badhamia obovata* [Peck] S. J. Smith) as occurring in temperate North America, but not specifically reported from Colorado.

A collection from Colorado labelled *Badhamia rubiginosa* (Chev.) Rost., determined by Macbride, is in BPI and one from Larimer County is in NYBG.

Fuligo cinerea (Schw.) Morgan, Jour. Cinc. Soc. Nat. Hist. 19:33. 1896.

Reported from Colorado by Sturgis in 1907, p. 22 (31) as *F. ellipsospora* (Rost.) List. from a collection made by Bethel in Gilpin County.

Collected also in Arapahoe County on bark of living cottonwood in moist chamber.

Fuligo intermedia Macbr., N. Am. Slime-Moulds ed. 2. 30. 1922.

Type locality: Colorado.

First described by Macbride in 1922 from a collection made by Bethel in Denver County.

Collected also in Douglas, Eagle, Gilpin and Summit counties on decayed wood and forest litter from spring to fall.

Fuligo megaspora Sturgis, Colo. Coll. Publ. Sci. 12:443. 1913.
Type locality: Colorado.
First described by Sturgis from collections made on twigs and dead bark of *Abies* and *Pinus*, Cheyenne Mountain, El Paso County, July, 1911.

Fuligo septica (L.) Wiggers, Prim. Fl. Holsat. 112. 1780.
Reported from Colorado by Sturgis in 1907, p. 22 (31) from Archuleta, Boulder, Douglas, El Paso, Gilpin, Grand, Jefferson and Ouray counties.
Collected also in Arapahoe, Clear Creek, Denver, Eagle, Gunnison, Park, Pitkin and Summit counties on rotten wood, forest litter, living plants and bare soil from spring to fall.

Leocarpus fragilis (Dicks.) Rost., Mon. 132. 1874.
Reported from Colorado by Sturgis in 1907, p. 23 (31) from El Paso and Gilpin counties.
Collected also in Boulder, Clear Creek, Douglas, Eagle, Grand, Gunnison, Jefferson and Summit counties on forest litter and living herbaceous plants from spring to fall.

Physarum albescens Ellis, ex Macbr., No. Am. Slime-Moulds ed 2. 86. 1922.
Type locality: Clear Creek County, Colorado.
First described from Colorado by Macbride in 1899, p. 82 (26) as *Leocarpus fulvous* based on a single collection made by Bethel in June, 1896 "on living willow growing in snow at 11,000 ft. (3,400 m) alt. Loveland Pass, (Clear Creek County) Colo". Sturgis in 1907, p. 23 (31) described it as a "very rare species" and noted its identity with *Physarum albescens* Phillips. For an interesting but confusing account of name changes over the past 70 years see Sturgis 1907, p. 24 (31), Macbride 1922, p. 87-89 (27) and Martin and Alexopoulos, p. 284 (30).
Collected also in Boulder, Chaffee, Custer, Douglas, Eagle, Gilpin, Grand, Larimer and Summit counties on grass, shrubs, leaves, dead and living twigs, forest litter and granite boulders near and under snowbanks in spring.
Observations: This alpine, "snowbank" slime mold produces massive fruitings over large areas of alpine meadows and forest floors in May and June between 2,800 and 3,400 m. Despite Sturgis' allusion to it as very rare, *P. albescens* is one of the most abundant of the Colorado snowbank species. We agree with Kowalski (20) that the variability of this species is far greater than previously recorded and cite his 1973 description as accurately describing our material. In our material the spore size varies only 1-2 µm in any given collection but varies from collection to collection from 10-12 µm in some to 13-15 µm in others, suggesting a range of (10-) 11-14 (-15) µm for the species. In many of our specimens (*4187*, *4287*, *4300*, *4307*) the peridium is porcelainized and in *6554* some irregular rhomboid crystals are present in the base of the peridium. In *5502* the lime nodes are small and scanty but in others they are large and numerous and, as described by Kowalski, "aggregated in the center to form an irregular small to massive pseudocolumella". In many collections (*4250*, *4287*, *4372*, *4609*, *4612*, *5502*, *6533*, *6552* and *6615*) some of the "hyaline" threads of capillitium contain a light brown pigment either as a diffuse discoloration of the narrow central portion of the thread or as a transverse brown ring ±1µm in width. There seems to be no

correlation of these unusual characters to indicate distinct varieties within this variable species.

Physarum alpinum (A.& G. Lister) G. Lister, Jour. Bot. 48:73. 1910.

New Colorado record.

Clear Creek Co.: On grass at edge of melting snow, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, April 25, 1976, *6516*; May 2, 1976, *6525*; April 11, 1976, *6456*; June 19, 1976, *6904*.

Gilpin Co.: On decayed wood in snowbank, Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, May 22, 1974, *4247*.

Physarum ?auriscalpium Cooke, Am. Lyc. N.Y. 11:384. 1877.

Reported from Colorado by Sturgis in 1907, p. 21 (31) from Boulder, El Paso and San Juan counties.

Collected also in Arapahoe, Custer, Delta, Denver, Jefferson, Ouray, Saguache and San Miguel counties on bark of juniper, cottonwood, elm and scrub oak in moist chamber.

Observations: All our material fits the description of Farr (7) in distinguishing this species from *P. decipiens* but it was all obtained from moist chamber fruitings. In view of the suggestion by Farr (9) that these two species may be conspecific, we have placed the (?) before the species name.

Physarum bethelii Macbr., ex Lister, Mycet. ed. 2. 1911.

Type locality: Tolland, Gilpin Co., Colorado.

Reported from Colorado by Sturgis in 1913, p. 439 (32) as *Physarum viride* var. *bethelii* from a collection made in August 1908 in El Paso County.

Collected also in Clear Creek, Eagle, Grand and San Juan counties on decayed wood in late summer and fall.

Observations: As Martin and Alexopoulos, p. 287 (30) suggest, this doubtful species bears little resemblance to *P. viride*. The plasmodium of *4815* was orange-red near vivid orange #48.

Physarum bitectum G. Lister, Mycet. ed. 2. 78. 1911.

Reported from Colorado by Macbride in 1922, p. 54 (27).

Collected in Boulder, Eagle, Gilpin, Larimer and Summit counties on inner bark of decaying aspen logs from early spring to late fall.

Observations: The spores in our collections all show ornamentation similar to that of *P. straminipes* with conspicuous light bands or ridges separating the clustered, dark warts.

Physarum bivalve Pers., Ann. Bot. Usteri 15:5. 1795.

Reported from Colorado by Sturgis, 1907, p. 18 (31) as *P. sinuosum* (Bull.) Weinm. from Boulder, Chaffee, El Paso, Gilpin and Jefferson counties.

Collected also in Clear Creek County on decayed aspen wood in summer.

Observations: Collection *8241* consists almost entirely of a plasmodiocarpous, intricately reticulate fruiting, while *8431* is wholly sporangiate with gregarious to scattered sporangia shaped like clam shells.

Physarum bogoriense Racib., Hedwigia 37:52. 18 F. 1898.

Reported from Colorado by Sturgis in 1907, p. 20 (31) as

Physarum pallidum (B. & C.) List. from a single collection made by Bethel in Gilpin County in October 1906.

Collected also in Clear Creek and Custer counties on dead leaves and decayed wood in late summer and fall.

Observations: The suggestion of Braun and Keller (5), that two varieties or species are included in the description of Martin and Alexopoulos (30), is of interest since the spores of *6997*, *6999* and *7859* are clustered, and darker than the free spores of *6969* and Bethel's collection at BPI.

Physarum brunneolum (Phill.) Massee, Mon. 280. 1892.

Reported from Colorado by Sturgis in 1913, p. 441 (32) from a a collection found on the dead bark of *Populus* on Mount Manitou, El Paso County in July, 1912.

Collected also in Clear Creek County on bark of conifer in summer.

Physarum carneum G. Lister & Sturgis, Jour. Bot. 48:73. 1910.

Type locality: Colorado.

Type specimen collected by Sturgis on dead wood on Cheyenne Mountain, El Paso County, September 10, 1908 (24).

Collected also in Clear Creek County on dead wood in summer.

Physarum cinereum(Batsch) Pers., Neues Mag. Bot. 1:89. 1794.

Reported from Colorado by Sturgis in 1907, p. 16 (31) from collections found by Bethel on grass, leaves and fallen twigs in Boulder and Jefferson counties.

Collected also in Clear Creek, Gilpin and Grand counties on dead wood and forest litter in summer.

Physarum citrinum Schum., Enum. Pl. Saell. 2:201. 1803.

Reported from Colorado by Macbride in 1922, p. 66 (27).

Physarum compressum Alb. & Schw., Consp. Fung. 97. 1805.

Reported from Colorado by Sturgis in 1907, p. 16 (31) as *P. nephroideum* Rost. from Boulder, Gilpin, Larimer, Mesa and Ouray counties.

Collected also in Douglas, El Paso and Jefferson counties on bark of elm and alder and on yucca in moist chamber. A collection from Archuleta County is in BPI.

Physarum conglomeratum (Fries) Rost., Mon. 108. 1874.

New Colorado record.

Clear Creek Co.: On grass, herbaceous stems and leaves, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, September 7, 1977, *8402*.

Observations: The smaller (8-10 μm), paler, smoother spores distinguish this species from *P. contextum*.

Physarum contextum (Pers.) Pers., Syn. Fung. 168. 1801.

Reported from Colorado by Sturgis in 1907, p. 16 (31) from collections on fallen twigs, leaves and bark from Boulder, El Paso and Jefferson counties.

Collected also in Eagle and Gilpin counties on bark and dead grass in summer.

Observations: In our material, as well as that studied at BPI, many collections have spores up to 15 μm and occasionally to 17 μm.

Even though the spore size stated in most texts [(10-) 11-13 (-14)] allows some overlap with the spore size of *P. conglomeratum*, the darker color and coarse ornamentation of the spores of *P. contextum* are diagnostic.

Physarum decipiens Curtis, Am. Jour. Sci. II. 6:352. 1848.

Reported from Colorado by Sturgis in 1913, p. 437 (32) as *Badhamia decipiens* (Curt.) Berk. from collections made on Cheyenne Mountain, El Paso County, in September, 1908 and August, 1909.

Collected also in Clear Creek and Gilpin counties on bark and forest litter in summer.

Observations: Two characteristics of our collections are noteworthy. The hypothallus, though inconspicuous, is reddish-brown to black and may be extended upward into weak stalks. The spores have clusters of darker spines with lighter bands between them as in *P. bitectum* and *P. straminipes*.

Physarum diderma Rost., Mon. 110. 1874.

Reported from Colorado by Sturgis in 1907, p. 18 (31) as both *P. testaceum* Sturgis, and *P. diderma* Rost. from collections by Bethel in Boulder and Ouray counties, on the bark of *Abies* in August 1905.

Collected also in Eagle and Larimer counties on stems of dead grass and herbaceous plants in summer.

Physarum didermoides (Pers.) Rost., Mon. 97. 1874.

Reported from Colorado by Sturgis in 1907, p. 18 (31) from Boulder County.

Collected also in Larimer County on decayed wood in summer.

Physarum famintzinii Rost., Mon. 107. 1874.

New Colorado record.

Clear Creek Co.: On decayed conifer stick, Chicago Creek (11 km southwest of Idaho Springs on Colo. 103) 2,700 m, August 24, 1977, *8449*.

Observations: This fruiting was 6 cm long and 3-4 cm wide, wrapped around the stick to form a honeycomb-like pseudoaethalium of sporangia that were crowded and in places, heaped.

Physarum flavicomum Berk., Lond. Jour. Bot. 4:66. 1845.

Reported from Colorado by Sturgis in 1907, p. 21 (31) as *P. berkeleyi* Rost. from a collection made in El Paso County in September, 1906.

Physarum globuliferum (Bull.) Pers., Syn. Fung. 175. 1801.

Described by Martin and Alexopoulos, p. 303 (30) as cosmopolitan, but not specifically reported from Colorado.

Three Colorado collections are in BPI. One is dated 1906, as labeled by T. H. Macbride; the second is dated 1907, collected by E. Bethel, determined by Macbride, and the third collected by E. C. Smith in Larimer County in 1931.

Physarum gyrosum Rost., Mon. 111. 1874.

New Colorado record.

Arapahoe Co.: On bark of living cottonwood in moist chamber, High Line Canal and So. University Blvd., 1,620 m, 1978, *8517*.

Boulder Co.: On bark of living cottonwood in moist chamber, 1.6

km east of Louisville, 1,600 m, 1979, *9342*.

Delta Co.: On bark of living juniper in moist chamber, Cedaredge, 2,000 m, 1978, *8986*.

Denver Co.: On bark of cottonwood, elm and grapevine in moist chamber, Denver, 1,600 m, 1978, *8550*.

Douglas Co.: On bark of living elm in moist chamber, 8 km south of Sedalia on county road 105, 1,850 m, 1978, *8356*.

Gilpin Co.: On bark of living angiosperm in moist chamber, 8 km south of Black Hawk on Colo. 119, 2,400 m, 1978, *8553*.

Jefferson Co.: On bark of living juniper in moist chamber, Mount Olivet Cemetery, 1,640 m, 1978, *8385*.

Physarum lateritium (Berk. & Rav.) Morgan, Jour. Cinc. Soc. Nat. Hist. 19:23. 1896.

Reported from Colorado by Sturgis in 1907, p. 21 (31) from a single collection made by Bethel in Boulder County, exsiccati in BPI.

Physarum leucophaeum Fries, Symb. Gast. 24. 1818.

Reported from Colorado by Sturgis in 1913, p. 442 (32) as *P. nutans* var. *leucophaeum* from El Paso County, 1912.

Collected also in Clear Creek, Gilpin, Pitkin, San Miguel and Summit counties on dead wood, moss and forest litter in summer.

Physarum leucopus Link, Ges. Nat. Freunde Berlin Mag. 3:27. 1809.

Reported from Colorado by Sturgis in 1913, p. 439 (32) from a single scanty collection made on Cheyenne Mountain, El Paso County, September, 1908.

Collected also in Eagle, Pitkin and Summit counties on decayed wood, and particularly aspen bark, in summer.

Observations: At least three variations occur. One (*8478*) has sulcate stalks with a few small veins at the base, but no apparent hypothallus. The second (*2075*) has a terete, beaded stipe with prominent veins at the base arising from a translucent sheet of hypothallus. The third (*7092*) has an extensive, limy, white to ochraceous hypothallus from which the stipes arise as weak furrowed extensions. Microscopically the three are identical and seem to intergrade.

Physarum listeri Macbr., in Macbr. & Martin, Myxom. 62. 1934.

Reported from Colorado by Sturgis in 1913, p. 439 (32) as *P. luteo-album* List. from a collection made on decayed wood in Custer County, in August, 1911, which was the first record of this species in America.

Physarum luteolum Peck, Ann. Rep. N.Y. State Mus. 30:50. 1878.

Reported from Colorado by Hagelstein in 1944, p. 76 (12.).

Collected in Gilpin County on bark of spruce near melting snow in June.

Physarum megalosporum Macbr., N. Am. Slime-Moulds ed. 2. 63. 1922.

Type locality: Colorado.

Reported from Colorado by Sturgis in 1917, p. 323 (33) as *P. melanospermum* Sturgis from collections on dead twigs and leaves in Arapahoe and El Paso counties in 1913 and 1914. One of these collections became the type specimen.

Collected also from moist chamber fruiting on juniper bark from Jefferson County.

Physarum mortonii Macbr., N. Am. Slime-Moulds ed. 2. 58. 1922.
Reported from Colorado by Lister in 1925, p. 60 (23) as *Physarum contextum* var. *"mortoni"* from a specimen collected by Bethel.

Physarum newtonii Macbr., Bull. Nat. Hist. Univ. Iowa 2:390. 1893.
Type Locality: Colorado.
First described by Macbride in 1893 (25) from a collection made by G. W. Newton on dead wood on Pikes Peak, El Paso County, Colorado.

Physarum notabile Macbr., N. Am. Slime-Moulds ed. 2. 80. 1922.
Reported from Colorado by Hagelstein in 1944, p. 61 (12).
Collected in Archuleta, Boulder, Clear Creek, Custer, Eagle, El Paso, Gilpin, Larimer, Park and Summit counties on dead wood, especially the inner bark of aspen, and aspen leaves in summer.
Observations: This is one of the most common summer-fruiting species of *Physarum* in the Colorado mountains. Text descriptions include broad variations and our material shows even greater variability, suggesting that more than one taxon may be involved. Most of our collections have dark stalks as described by Martin and Alexopoulos, p. 315 (30), but many collections have yellowish, buff or red-brown stalks as described for *P. connatum* by Lister, p. 51 (23) which is now placed in synonymy. The amount of lime in the peridium varies greatly. When the lime is scanty the peridium shows a blue iridescence; on the other hand it may be so densely encrusted with lime as to appear double. The hypothallus is also variable, from inconspicuous translucent basal discs with yellow-brown strands extending into the ribs of the stalk in scattered sporangia, to a massive brown to black confluent sheet in crowded fruitings.

Physarum nudum Macbr., in Peck & Gilbert, Am. Jour. Bot. 19:134. 1932.
New Colorado record.
Clear Creek Co.: On decayed wood and forest litter, Chicago Creek (11 km southwest of Idaho Springs on Colo. 103) 2,700 m, August 21, 1977, *7895, 8434;* August 24, 1977, *8200, 8207*.
Delta Co.: On bark of living juniper in moist chamber, Cedaredge, 1,500 m, 1979, *9254*.

Physarum nutans Pers., Am. Bot. Usteri 15:6. 1795.
Reported from Colorado by Sturgis in 1907, p. 14 (31) from Boulder, El Paso, Gilpin, Larimer and Ouray counties.
Collected also in Clear Creek, Eagle and Summit counties on dead wood in summer.

Physarum oblatum Macbr., Bull. Nat. Hist. Univ. Iowa 2:384. 1893.
Reported from Colorado by Sturgis in 1913, p. 440 (32) as *P. maydis* Morgan from a collection on Cheyenne Mountain, El Paso County, August, 1912.
Collected also in Boulder, Clear Creek and Larimer counties on decayed wood in summer.

Physarum polycephalum Schw., Schr. Natur. Ges. Leipzig 1:63. 1822.
Described by Martin and Alexopoulos, p. 322 (30) as being widely distributed in the United States, but not specifically reported from Colorado.
Douglas Co.: On bark of living angiosperm in moist chamber, Larkspur, 2,000 m, 1978, *8729*.

Physarum pulcherrimum Berk. & Rav., Grevillea 2:65. 1873.

Reported from Colorado by Martin & Alexopoulos in 1969, p. 324 (30).

Two collections made by Bethel in 1913 and 1914 are in BPI.

Physarum pusillum (Berk. & Curt.) G. Lister, Mycet. ed. 2. 64. 1911.

Reported from Colorado by Sturgis in 1913, p. 441 (32) from a collection made on dead twigs and leaves in El Paso County, August, 1912.

Collected also in Adams and Summit counties on dead wood and living herbaceous plants in summer, and in Clear Creek, Denver, Douglas, Gilpin, Jefferson and San Miguel counties on bark of cottonwood, elm, grape and juniper in moist chamber.

Physarum rubiginosum Fries, Symb. Gast. 21. 1917.

Reported from Colorado by Macbride in 1922, p. 62 (27) from a collection made by Bethel in El Paso County.

Collected also in Boulder, Clear Creek, Eagle and Grand counties on dead wood, aspen leaves and living herbaceous plants in summer.

Physarum stellatum (Massee) Martin, Mycologia 39:461. 1947.

Reported from Colorado by Sturgis in 1907, p. 22 (31) as *P. compactum* (Wing.) List. quoting Macbride's manuscript, but not found by Sturgis. Described by Martin and Alexopoulos in 1969, p. 331 (30) as being widely distributed in North America, but not specifically reported from Colorado.

Clear Creek Co.: On decayed conifer wood, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, September 10, 1977, *8301*, *8302*, *8317*, *8329*.

Summit Co.: On decayed spruce wood, Spring Creek (28 km southwest of Kremmling on Colo. 9) 2,900 m, August 9, 1976, *6886*.

Physarum sulphureum Alb. & Schw., Consp. Fung. 93. 1805.

Reported from Colorado by Lister in 1925, p. 26 (23) from collections made by Sturgis in Custer County.

Physarum superbum Hagelst., Mycologia 32:385. 1940.

Described by Martin and Alexopoulos, p. 333 (30) as being widely distributed over North America, but not specifically reported from Colorado.

Clear Creek Co.: On bare granite boulder near melting snow, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, May 5, 1976, *6706*.

Physarum vernum Somm., in Fries, Syst. Myc. 3:146. 1829.

Reported from Colorado by Sturgis in 1907, p. 17 (31) from a collection made by Bethel in Denver County in September, 1906.

Collected also in Boulder, Clear Creek, Eagle, Gilpin, Park and Summit counties on dead grass, dead and living herbaceous stems, decayed wood, aspen leaves and bare granite from spring to fall.

Observations: Though *P. vernum* is described as having a single, rugulose, membranous peridium, this is true in only a slight majority of our collections; in these, the lime is relatively scant. Almost half our specimens are very limy and the wall appears to consist of two tightly appressed layers.

Physarum virescens Ditmar, in Sturm, Deuts. Fl. Pilze 1:123. 1817.
Reported from Colorado by Sturgis in 1913, p. 443 (32) from a collection made on the bark of fallen *Abies* at Tolland, Gilpin County, late in August 1912.

Physarum viride (Bull.) Pers., Ann. Bot. Usteri 15:6. 1795.
Reported from Colorado by Sturgis in 1907, p. 14 (31) from collections in Boulder, El Paso and Gilpin counties.

Collected also in Clear Creek and Eagle counties on dead wood and old polypores in summer.

Protophysarum phloiogenum Blackwell & Alexopoulos, Mycologia 67 (1): 32. 1975.
Type locality: Colorado.

First reported from Colorado by Blackwell and Alexopoulos from moist chamber fruitings on bark of living American elm collected in Boulder County, May 1965.

Collected also from moist chamber fruitings on bark of living cottonwood, elm, grape stems, yucca and miscellaneous angiosperms from Arapahoe, Denver, Douglas and Jefferson counties.

Observations: A collection that fruited on yucca contained some sporangia that were over 300 µm in diameter, twice the maximum size stated in the original description of this species.

ORDER STEMONITALES

Amaurochaete atra (Alb. & Schw.) Rost., Mon. 211. 1874.
Reported from Colorado by Macbride in 1922, p. 150 (27) as *A. fuliginosa* (Sowerby) Macbr.

Amaurochaete ferruginea Macbr. & Martin, Jour. Wash. Acad. 22:89. 1932.
Reported from Colorado by Martin and Alexopoulos in 1969, p. 173 (30).

Comatricha aequalis Peck, Ann. Rep. N.Y. State Mus. 31:42. 1879.
Reported from Colorado by Sturgis in 1907, p. 34 (31) as *C. nigra* var. *aequalis* Pk. from a collection made by Bethel in Boulder County.

Comatricha alpina Kowalski, Madrono 22(3):152. 1973.
New Colorado record.

Clear Creek Co.: On decorticate spruce wood near melting snow, Loveland Pass, 3,400 m, June 23, 1979, *9609*.

Eagle Co.: On decayed conifer wood in melting snow, West Lake Creek (14 km south of I-70) 3,100 m, July 12, 1975, *5859*.

Grand Co.: On decorticate conifer wood in snowbank, east of Church's Park (13 km southwest of Tabernash) 3,100 m, June 21, 1975, *5741*.

Summit Co.: On decayed wood, Spring Creek (22 km southwest of Kremmling) 2,800 m, August 14, 1971, *3089*.

Comatricha elegans (Racib.) G. Lister, Guide Brit. Mycet. ed. 3. 31. 1909.
Reported from Colorado by Sturgis in 1913, p. 448 (32) from collections made in Custer and El Paso counties in July and August, 1912.

Collected also in Boulder, Delta, Denver, Jefferson, Saguache and San Miguel counties on bark of cottonwood, Douglas fir, juniper, Russian olive and scrub oak in moist chamber.

Comatricha fimbriata G. Lister & Cran, in G. Lister, Jour. Bot. 55:122. 1917. New Colorado record.

El Paso Co.: On bark of dead Douglas fir, in moist chamber, Helen Hunt's Grave, Colorado Springs, 3,000 m, 1978, *8814*.

Mineral Co.: On decayed wood, Wolf Creek Pass (3 km west of the summit on U.S. 160) 3,200 m, July 20, 1976, *6941*.

Comatricha irregularis Rex, Proc. Acad. Phila. 43:393. 1891.

Reported from Colorado by Sturgis in 1907, p. 34 (31) from collections made in Boulder and Larimer counties, on cottonwood logs in August, 1906.

Collected also in Custer and Gilpin counties on litter in mixed woods in summer.

Comatricha laxa Rost., Mon. 201. 1874.

Reported from Colorado by Sturgis in 1907, p. 34 (31) from Bethel's collections in Adams, Boulder and Gilpin counties.

Collected also in Chaffee and Clear Creek counties on decayed wood in spring and in Arapahoe, Denver, Douglas, El Paso, Jefferson and Saguache counties on bark of cottonwood, elm, juniper, Douglas fir and Russian olive in moist chamber.

Comatricha nigra (Pers.) Schroet., Krypt.-Fl.Schles. 3(1):118. 1885.

Reported from Colorado by Sturgis in 1907, p. 33 (31) from Boulder, Denver, El Paso, Gilpin and Ouray counties.

Collected also in Clear Creek, Eagle, Grand, Huerfano, Jefferson and Summit counties on dead wood from early spring to late fall.

Comatricha pulchella (C. Bab.) Rost., Mon. App. 27. 1876.

Reported from Colorado by Sturgis in 1907, p. 34 (31) as *C. persoonii* Rost. from a single collection by Bethel in San Juan County in July, 1897, on dead leaves.

Comatricha rubens A. Lister, Mycet. 123. 1894.

Reported from Colorado by Lister in 1925, p. 148 (23).

Collected in Summit County on decorticate aspen wood in summer.

Comatricha suksdorfii Ellis & Ev., Bull. Washburn Lab. Nat. Hist. 1:5. 1894.

Reported from Colorado by Sturgis in 1907, p. 33 (31) as *C. nigra* var. *suksdorfii* Ell. & Ev. from collections by Bethel in Gilpin and Grand counties.

Collected also in Clear Creek, Eagle, Mineral, Park and Summit counties on decorticate conifer wood at the edge of melting snowbanks in early spring.

Observations: This common snowbank slime mold fruits in the same areas and at the same time as an even more common robust, black *Comatricha* here tentatively referred to *C. ?nodulifera* Wollm. & Alexop. (see below).

Comatricha typhoides (Bull.) Rost., in Lister, Mycet. 120. 1894.

Reported from Colorado by Sturgis in 1907, p. 34 (31) as *C.*

typhina (Wigg.) Rost. from collections in Boulder, El Paso, Gilpin, Ouray and San Juan counties.

Collected also in Clear Creek, Eagle, Grand and Summit counties on decayed conifer wood in summer.

Comatricha sp. (? nodulifera Wollm. & Alexop., Canad. J. Bot. 46:157. 1968.)

Collected in Boulder, Clear Creek, Eagle, Gilpin, Grand, Mineral, Park and Summit counties on decorticate conifer wood, in melting snowbanks.

Observations: This species, even more common than *C. suksdorfii*, is represented by 50 Colorado collections from the above counties. It is also known from Oregon (Farr *4400* and *4457*) and from Washington (DBG *6807*, *6812*, and *6828*). Structurally, it closely resembles *C. nodulifera* Wollman and Alexopoulos, but is much larger and more robust in all aspects, and has denser, darker capillitium and larger, more strongly marked and differently colored spores. Unfortunately, *C. nodulifera* is known only from moist chamber and laboratory cultures, while our species is represented only by field collections. Unless field collections fitting into *C. nodulifera* are found, or until the robust Colorado slime mold can be cultured, the relationship between these two entities will remain uncertain. Currently we cannot escape the possibility that *C. nodulifera* represents a depauperate development conspecific with the field-collected specimens. If fruited under natural conditions, it would most likely reflect the more typical expression of the species.

Enerthenema berkeleyanum Rost., Mon. App. 29. 1876.

Reported from Colorado by Sturgis in 1913, p. 448 (32) as *E. syncarpon* from collections on decayed pine in Archuleta County, August 1911.

Enerthenema melanospermum Macbr. & Martin, in Martin, Jour. Wash. Acad. 22:91. 1932.

New Colorado record.

Clear Creek Co.: On spruce wood, near melting snow, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, May 18, 1974, *4233*.

Eagle Co.: On decorticate conifer wood near melting snow, West Lake Creek (11 km south of I-70) 3,000 m, July 4, 1975, *5831*.

Grand Co.: On decayed conifer wood, near melting snow, Church's Park (16 km southwest of Tabernash) 3,000 m, June 21, 1975, *5737*.

Huerfano Co.: On decayed spruce wood, near melting snow, Apishapa Pass (pass summit, 40 km south of Walsenburg) 3,400 m, June 15, 1974, *4603*.

Summit Co.: On decayed lodgepole pine, in and near melting snowbanks, Spring Creek (24 km southwest of Kremmling on Colo. 9) 2,700 m, May 5, 1974, *4203*.

Observations: This species differs from *E. papillatum* not only by its larger sporangia, discs and spores, but also by its intensely black color, and by its capillitium being beaded throughout the entire length. Furthermore, *E. melanospermum* is limited to snowbank fruitings.

Enerthenema papillatum (Pers.) Rost., Mon. App. 28. 1876.

Reported from Colorado by Sturgis in 1907, p. 34 (31) from collections in Boulder, El Paso and Gilpin counties.

Collected also in Clear Creek, Douglas, Eagle, Lake, Pitkin and Summit counties on decorticate conifer wood, often associated with lichen and algae, in summer.

Observations: This smaller, lighter brown species fruits only in summer. Its capillitium is smooth throughout most of its length and beaded only at the tips in contrast to that of *E. melanospermum*. Despite the obvious differences in the two species above, we have found seven moist chamber fruitings which are intermediate between the two in that the stature and size of the disc resemble *E.papillatum* but the spore size is that of *E. melanospermum*. The color is intermediate between the two and the capillitium is distinct from both in that it is smooth throughout the entire length and has expanded, branched tips. We have not found either *E. melanospermum* or *E. papillatum* in moist chamber.

Lamproderma arcyrioides (Sommerf.) Rost., Mon. 206. 1874.

Reported from Colorado by Sturgis in 1907, p. 35 (31) as *L. violaceum* (Fr.) Rost. from two of Bethel's collections, one from Ouray County.

Collected also in Clear Creek, Douglas, Eagle, Grand, Huerfano and Summit counties, in and near melting snowbanks in spring, on decorticate conifer wood and on a bare granite boulder.

Lamproderma atrosporum Meylan, Bull. Soc. Vaud. Sci. Nat. 46:51. 1910.

Described by Martin and Alexopoulos, p. 213 (30) as occurring in the mountains of the western United States, but not specifically reported from Colorado.

Clear Creek Co.: On decayed wood near melting snow, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, June 13, 1973, *3693*.

Douglas Co.: On herbaceous stems and living leaves, in melting snow, Jarre Canyon road (21 km southwest of Sedalia) 2,600 m, May 12, 1974, *4311*.

Eagle Co.: On twigs, grass, herbaceous stems and leaves near melting snow, West Lake Creek (8 km south of I-70) 2,600 m, May 9, 1976, *6562*.

Gilpin Co.: On dead bark near melting snow, Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, June 9, 1973, *3685*.

Grand Co.: On decayed conifer bark in melting snow, Church's Park, (16 km southwest of Tabernash) 3,000 m, June 17, 1978, *8846*.

Huerfano Co.: On decayed wood near melting snow, Apishapa Pass summit (40 km south of Walsenburg) ±3,500 m, June 15, 1974, *4611*.

Summit Co.: On granite boulder near melting snow, Spring Creek (28 km southwest of Kremmling on Colo. 9) ±2,900 m, May 20, 1973, *3655*.

Observations: Our collections fit the very detailed description by Kowalski (18). The sporangia range from stipitate and globose to sessile and clavate and from 1.0-2.5 mm in height. In globose sporangia, the columella usually ends abruptly at the center of the sporangium whereas, in elongated ones, it may attain two-thirds the length of the sporangium.

Lamproderma carestiae (Ces. & de Not.) Meylan, Bull. Soc. Vaud. Sci. Nat. 57:368. 1932.

Reported from Colorado by Hagelstein in 1944, p. 175 (12) as

L. violaceum var. *carestiae* (Ces. & de Not.) Lister.
Collected in Clear Creek, Eagle, Gilpin, Grand, Mineral and Summit counties, near melting snowbanks on leaves, dead wood, bare granite, and herbaceous stems, in spring.

Lamproderma columbinum (Pers.) Rost., in Fuckel, Jahrb. Nass. Ver. Nat. 27-28:69. 1873.

Described by Martin and Alexopoulos, p. 214 (30) as occurring in temperate North America, but not specifically reported from Colorado.

Denver Co.: On dead leaf, 1,600 m, 1910, collected by J. R. Weir, exsiccati in BPI.

Eagle Co.: On decayed conifer wood, West Lake Creek (9 km south of I-70) 2,800 m, August 15, 1970, *2731;* August 28, 1971, *2954.*

Gunnison Co.: Cottonwood Lake, 2,900 m, June 21, 1930, collected by R. W. Davidson, exsiccati in BPI; Gothic Natural Area, 3,100 m, July 4, 1955, collected by W. A. Weber, COLO *M-128.*

Mesa Co.: Mesa Lake, 2,800 m, June 16 & 17, 1930, two collections by R. W. Davidson, exsiccati in BPI.

Ouray Co.: Collected by Bethel, exsiccati in BPI.

Summit Co.: On decayed conifer wood, Elliott Ridge (30 km southwest of Kremmling) 3,400 m, July 31, 1976, *6840.*

Lamproderma cribrarioides (Fries) R. E. Fries, Sv. Bot. Tidskr. 4:259. 1911.

Reported from Colorado by Macbride and Martin in 1934, p. 194 (28) from collections made by Seaver and Shope in 1929 from Boulder County.

Collected in Clear Creek, Douglas, Eagle and Summit counties in and near melting snowbanks on decayed wood, twigs, grass, herbaceous stems and forest litter in spring.

Observations: Despite Macbride's observation that the Colorado material had uniform spore size (14-16 μm), our collections show a wide range of variation from 12 to 19 μm, as originally described by Lister (23) and reaffirmed by Kowalski (18). They also show a marked variation in spore ornamentation: from a pronounced coarse, completely banded reticulation to faint, low, unconnected ridges. The peridium is pitted, especially over the lower one-third, where the expanded funnel-like tips of the capillitium are firmly attached.

Lamproderma cristatum Meylan, Bull. Soc. Vaud. Sci. Nat. 53:457. 1921.

New hemisphere record.

Douglas Co.: On dead (?) aspen leaves under melting snowbank, Rampart Range (21 km southwest of Sedalia on Colo. 67) 2,600 m, May 12, 1974, *4317.*

Lamproderma echinosporum Meylan, Bull. Soc. Vaud. Sci. Nat. 55:241. 1924.

New Colorado record.

Clear Creek Co.: On grass, leaves and herbaceous stems under melting snowbanks, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, April 25, 1976, *6511.*

Eagle Co.: On decayed wood and herbaceous stems in melting snow, West Lake Creek (9 km south of I-70) 2,800 m, June 11, 1977, *8028* (determination confirmed by D. T. Kowalski).

Gilpin Co.: On decayed aspen wood and bark near melting snow, Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, May 22, 1974, *4243*.

Summit Co.: On decayed wood near melting snow, Spring Creek (28 km southwest of Kremmling on Colo. 9) 2,900 m, May 19, 1973, *3651;* May 20, 1978, *8718* (determination confirmed by D. T. Kowalski).

Lamproderma fuscatum Meylan, Bull. Soc. Vaud. Sci. Nat. 57:372. 1932.

New Colorado record.

Clear Creek Co.: On dead wood in and near melting snowbanks, Squaw Pass (9 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,800 m, May 29, 1976, *6637;* (6.5 km west of Bergen Park) 2,600 m, May 19, 1976, *6625;* June 19, 1976, *6650* (determination confirmed by D. T. Kowalski).

Lamproderma gulielmae Meylan, Bull. Soc. Vaud. Sci. Nat. 52:449. 1919.

Reported from Colorado by Lister in 1925, p. 158 (23).

Lamproderma maculatum Kowalski, Mycologia 62(4): 654. 1970.

New Colorado record.

Clear Creek Co.: On decayed conifer wood near melting snow, Squaw Pass (6.5 km west on Colo. 103 from Bergen Park junction with U.S. 73) 2,600 m, May 11, 1974, *4210* (determination confirmed by D. T. Kowalski).

Lamproderma sauteri Rost., Mon. 205. 1874.

Reported from Colorado by Sturgis in 1907, p. 35 (31) from a collection made by Bethel in 1902.

Collected in Boulder, Clear Creek, Custer, Douglas, Eagle, Gilpin, Grand and Summit counties on decaying wood, both conifer and aspen, stems of grass and herbaceous plants, aspen leaves and granite boulders, in and near snowbanks in early spring.

Observations: This variable species is the most common *Lamproderma* in the central Colorado Rockies and fruits abundantly in the spring near melting snowbanks. Some fruitings extend over an area of one to two meters by twenty to thirty cm covering, like a splash of blue paint, all the fallen logs, dead grass and herbaceous stems in the area, as the edge of the covering snowbank recedes.

Lamproderma scintillans (Berk. & Br.) Morgan, Jour. Cinc. Soc. Nat. Hist. 16:131. 1894.

Reported from Colorado by Sturgis in 1913, p. 449 (32) from collections in El Paso County in August 1908 and El Paso and Gilpin counties in August 1912.

Collected also in Clear Creek, Custer and Eagle counties on dead aspen bark and aspen leaves in summer.

Leptoderma iridescens G. Lister, Jour. Bot. 51:1. 1913.

Reported from Colorado by Hagelstein in 1944, p. 139 (12) from a single collection by Dr. E. C. Smith, which was apparently a new record for this hemisphere.

Collected in Clear Creek County on decorticate conifer wood in summer.

Stemonitis axifera (Bull.) Macbr., N. Am. Slime-Moulds 120. 1889.

Reported from Colorado by Sturgis in 1907, p. 32 (31) and again in 1913, p. 447 (32) as *S. ferruginea* Ehrenb. from collections in

Boulder, El Paso, Gilpin and San Juan counties.

Collected also in Clear Creek, Eagle, Huerfano, Pitkin and Summit counties on dead wood in summer.

Stemonitis confluens Cooke & Ellis, Grevillea 5:51. 1876.

Reported from Colorado by Sturgis in 1907, p. 31 (31) as *S. splendens* var. *confluens* (Cooke & Ellis) A. Lister from a collection found in Denver.

Collected also in Boulder and Summit counties on Englemann spruce bark in summer.

Stemonitis flavogenita Jahn, Verh. Bot. Ver. Brand. 45:165. 1904.

Described as widespread by Martin and Alexopoulos, p. 193 (30), but not specifically reported from Colorado.

Boulder Co.: On decayed wood, 8 km southwest of Lyons, 2,150 m, August 24, 1958, COLO *M-241*.

Clear Creek Co.: On decayed angiosperm wood, Montane Ridge (1.5 km south of Idaho Springs) 2,300 m, July 26, 1974, *4529*.

Eagle Co.: On decayed conifer wood, West Lake Creek (9 km south of I-70) 2,800 m, September 11, 1976, *7273*.

Gilpin Co.: On decayed aspen wood, Pickle Gulch (9 km north of Black Hawk on Colo. 119) 2,800 m, August 26, 1975, *6050*.

Summit Co.: On decayed conifer wood, Spring Creek (24 km southwest of Kremmling on Colo. 9) 2,700 m, July 28, 1973, *3826*.

Stemonitis fusca Roth, Mag. Bot. Romer & Usteri 1(2):26. 1787.

Reported from Colorado by Sturgis in 1907, p. 30-31 (31) from collections in Boulder, El Paso and Gilpin counties.

Collected also in Clear Creek, Custer, Eagle, Gunnison, Mineral, Park and Summit counties on decayed wood in summer.

Observations: Half of our collections fit var. *fusca*, one-third are typical of var. *papillosa* Meyl. as defined by Martin and Alexopoulos, p. 194 (30), and four collections are typical of var. *rufescens* A. Lister (23).

Stemonitis herbatica Peck, Ann. Rep. N.Y. State Mus. 26:75. 1874.

Reported from Colorado by Sturgis in 1907, p. 31 (31) from collections in Boulder, El Paso, Gilpin and San Juan counties.

Collected also in Clear Creek County on dead wood in summer.

Stemonitis hyperopta Meylan, Bull. Soc. Vaud. Sci. Nat. 52:97. 1918.

Reported from Colorado by Hagelstein in 1944, p. 145 (12).

Stemonitis nigrescens Rex, Proc. Acad. Phila. 43:392. 1891.

Described by Martin and Alexopoulos, p. 198 (30) as known from widely scattered localities in the United States, but not specifically reported from Colorado.

Larimer Co.: Collected by E. C. Smith at Cedar Cove, Big Thompson Canyon, 1,650 m, 1931, exsiccati in BPI.

Stemonitis smithii Macbr., Bull. Nat. Hist. Univ. Iowa 2:381. 1893.

Reported from Colorado by Sturgis in 1907, p. 33 (31).

Collected in Clear Creek and Gilpin counties on dead wood in summer.

Stemonitis splendens Rost., Mon. 195. 1874.

Reported from Colorado by Sturgis in 1907, p. 31 (31) from collections in Boulder, Denver, El Paso and Ouray counties.

Collected also in Custer County, exsiccati in COLO.

Stemonitis uvifera Macbr., N. Am. Slime-Moulds ed. 2. 161. 1922.

New Colorado record.

Summit Co.: On dead wood in the Gore Wilderness area (9 km west of Heeney) 2,500 m, August 11, 1976, *7119*.

Stemonitis virginiensis Rex, Proc. Acad. Phila. 43:391. 1891.

Reported from Colorado by Hagelstein in 1944, p. 145 (12).

Collected in Clear Creek, Gilpin and Larimer counties on dead wood in summer.

ACKNOWLEDGEMENTS

We thank Dr. Constantine J. Alexopoulos for identifying specimens and reading the manuscript; Drs. M. Blackwell, M. S. Gilliam, H. W. Keller, D. T. Kowalski, K. McKnight and E. Nannenga-Bremekamp for identifying specimens and helpful suggestions and Drs. C. T. Rogerson and P. K. Holmgren, New York Botanic Gardens (NYBG), W. A. Weber, University of Colorado (COLO) and R. L. Hartman and P. M. Fazio, University of Wyoming (RM) for the loan of specimens from their herbaria and from the Wilhelm G. Solheim collection.

BIBLIOGRAPHY

1. Alexopoulos, C. J. and J. A. Sáenz. 1975. "The Myxomycetes of Costa Rica." *Mycotaxon* 2(2): 223-271.
2. Angel, K. and D. T. Wicklow. 1975. "Relationships between coprophilous fungi and fecal substrates in a Colorado grassland." *Mycologia* 67(1): 63-74.
3. Anonymous (Kelly, K. L. and D. B. Judd. 1965). "ISCC-NBS color-name charts illustrated with centroid colors." Standard sample #2106. Suppl. to Nat'l. Bur. Standards Circ. 553, U. S. Government Printing Office, Washington, D. C.
4. Blackwell, M. and C. J. Alexopoulos. 1975. "Taxonomic studies in the Myxomycetes IV. Protophysarum phloiogenum, a new genus and species of Physaraceae." *Mycologia* 67(1): 32-37.
5. Braun, K. L. and H. W. Keller. 1976. "Myxomycetes of Mexico I." *Mycotaxon* 3(2): 297-317.
6. Cooke, W. B. 1968. "The 1964 Colorado foray." *Mycologia* 60(5): 1093-1098.
7. Farr, M. L. 1961. "Badhamia decipiens reinstated in Physarum." *Brittonia* 13(4): 339-345.
8. Farr, M. L. 1962. "Arcyria cinerea and A. pomiformis revised." *Mycologia* 54(5): 516-520.
9. Farr, M. L. 1967. "Notes on Myxomycetes." *Mycopathologia et Mycologia Applicata* 31(3/4): 305-313.
10. Farr, M. L. 1974. "Some new myxomycete records from the neotropics and some taxonomic problems in the Myxomycetes." *Proceedings Iowa Academy Sci.* 81(1): 37-40.
11. Farr, M. L. 1976. *Flora neotropica monograph no. 16 Myxomycetes.* New York Botanic Gardens, New York. 304 p.

11a. Farr, M.L. 1979. In press (Nova Hedwigia).
12. Hagelstein, R. 1944. *The Mycetozoa of North America.* Publ. by the author. Mineola, New York. 306 p, 16 pl.
13. Kauffman, C.H. 1921. "The mycological flora of the higher Rockies of Colorado." *Papers Mich. Acad. Sci.* 1: 101-150.
14. Keller, H. W., H. C. Aldrich, T. E. Brooks, and J. D. Schoknecht. 1975. "The taxonomic status of Badhamia ovispora: A Myxomycete with unique spores." *Mycologia* 67(5): 1001-1011.
15. Keller, H. W. and T. E. Brooks. 1976. "Corticolous Myxomycetes IV: Badhamiopsis, a new genus for Badhamia ainoae." *Mycologia* 68(4): 834-841.
16. Kowalski, D. T. 1967. "Observations on the Dianemaceae." *Mycologia* 59(6): 1075-1084.
17. Kowalski, D. T. 1968. "Observations on the genus Lamproderma." *Mycologia* 60(4): 756-768.
18. Kowalski, D. T. 1970. "The species of Lamproderma." *Mycologia* 62(4): 621-672.
19. Kowalski, D. T. 1971. "The genus Lepidoderma." *Mycologia* 63(3): 490-516.
20. Kowalski, D. T. 1973. "Notes on western Myxomycetes." *Madrono* 22(3): 151-153.
21. Kowalski, D. T. 1974. "Notes on two species of Trichia." *Mycologia* 66(2): 369-374.
22. Kowalski, D. T. 1975. "The myxomycete taxa described by Charles Meylan." *Mycologia* 67(3): 448-494.
23. Lister, A. 1925. *A monograph af the Mycetozoa.* (ed. 3 rev. G. Lister), British Museum, London. 296 p, 222 pl.
24. Lister, G. and W. C. Sturgis. 1910. "Two new Mycetozoa." *Journal of Botany* 48:73.
25. Macbride, T. H. 1893. "A new Physarum from Colorado." *Bull. Lab. Nat. Hist. Univ. Iowa* 2:390.
26. Macbride, T. H. 1899. *The North American Slime-Moulds.* Macmillan Co., New York. 231 p, 18 pl.
27. Macbride, T. H. 1922. *The North American Slime-Moulds* (ed. 2). Macmillan Co., New York. 299 p, 23 pl.
28. Macbride, T. H. and G. W. Martin, 1934. *The Myxomycetes.* Macmillan Co., New York. 339 p, 21 pl.
29. Martin, G. W. 1932. "New species of slime-molds." *Journal of the Washington Academy* 22(4): 88-92.
30. Martin, G. W. and C. J. Alexopoulos. 1969. *The Myxomycetes.* University of Iowa Press, Iowa City. 560 p, 41 pl.
31. Sturgis, W. C. 1907. "The Myxomycetes of Colorado." *Colorado College Pubs. Sci. Ser.* 12: 1-43.
32. Sturgis, W. C. 1913. "The Myxomycetes of Colorado, part II." *Colorado College Pubs., Sci. Ser.* 12: 435-454.
33. Sturgis, W. C. 1917. "Notes on new or rare Myxomycetes." *Mycologia* 9(6): 323-333.

MYCOTAXON

Vol. X, No. 2, p. 350 January-March 1980

VALIDATION OF ENTOMOPHTHORA AQUATICA[1]

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Entomophthora aquatica infecting larvae and pupae of *Aedes canadensis* and larvae of *Culseta morsitans* was described by Anderson and Ringo (1969), but no holotype was listed. The name is therefore invalid under article 37.1 of the International Code of Botanical Nomenclature. In this note we validate the name by listing below a holotype and referring to the previously published Latin description.

Entomophthora aquatica Anderson & Ringo *ex* Anderson & Anagnostakis[2] sp. nov.
= *Entomophthora aquatica* Anderson & Ringo, J. Invert. Pathol. 13:386. 1969. (invalid, Art. 37.1).
Holotype: on *Aedes canadensis*, June 4, 1968, Granby, Hartford Co., Connecticut (FH).
Paratype: on *Aedes canadensis*, May 25, 1968, Granby, Hartford Co., Connecticut (FH).
Type specimens are microscope slides of hematoxylin-eosin stained sections.

REFERENCE

Anderson, J. F. and S. L. Ringo. 1969. *Entomophthora aquatica* sp. n. infecting larvae and pupae of floodwater mosquitoes. J. Invert. Pathol. 13:386-393.

[1] The authors are grateful to D. H. Pfister for help in preparing this note.

[2] S. L. Ringo = Sandra L. Anagnostakis

MYCOTAXON

Vol. X, No. 2, pp. 351-364 January-March 1980

ANALYSIS OF THE BASIDIUM OF HIGHER BASIDIOMYCETES ON THE BASIS OF GEOMETRICAL DEPENDENCIES

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SUMMARY

This paper deals with studies of spore-spacing on basidia. The location of sterigmata and spores on basidia is associated with definite constants having a taxonomic trend. We have formulated 4 properties of the basidium new to science: *1*. The ratio of the outer circle and basidium outline diameters is equal to the ratio of the central and inner circles diameters and also to the ratio of the spore outline and sterigmatic patch diameters. *2*. The ratio of the central and inner circles diameters is equal to the ratio of the spore outline and sterigmatic patch diameters. *3*. The ratio of the central circle and spore outline diameters is equal to the ratio of the inner circle and sterigmatic patch diameters. *4*. The sum of the values which are inverse to the coefficients n and q is equal to 1. The data obtained on the basis of studying the geometric dependencies of the basidium and, in particular, the discovery of new parameters permitted us to use them as additional criteria of taxa of different ranks in higher Basidiomycetes.

Studies of higher Basidiomycetes are of great scientific interest as only a few genera have been subjected to critical analysis. At the same time differentiation of species and other taxonomic units as well as elucidation of phylogeny are complicated due to the polymorphism peculiar to them, notably phenomena of parallellism and convergence.

Disputable positions in systematics of species, genera, families and orders of higher Basidiomycetes point to an urgent need to evaluate the existing and to search for new, reliable, objective criteria determining characters of leading significance which are peculiar to taxa of all ranks.

Considerable attention should be given to studies of spores and basidia as they, being the generative organs, are subject to the least extent to the influences of environment. The studies of a few authors (Corner, 1947, 1948, 1950, 1968, 1972; Malençon, 1958; Perreau-Bertrand, 1967) showed that the sizes of spores, sterigmata and basidia are bound by definite constants having species and generic trends. In taxonomic descriptions, however, the sizes of spores, sterigmata and basidia are given independently, though they are interrelated and to a considerable extent depend on the character of the generative hypha. The accurate establishment of these dependencies may result in one of the most reliable criteria of the species and of the genus in higher Basidiomycetes.

The geometry of spore position on the basidium has species and generic trends. As was stated by Corner (1972, p. 159), "...the problem [of basidial geometry] has loomed continually and is fundamental to the classification of the species [of the genus *Boletus*]."

Analysis of the basidium on the basis of geometrical dependencies opens a new trend in the studies of higher Basidiomycetes. These studies will help us understand the interrelation and interdependence among hymenial elements as well as to answer the question: how is the accuracy of spore-spacing on the basidium explained? And all these data will help to characterize and better evaluate the basidiocarp itself.

The study presented here deals with analysis of the geometrical peculiarities of spore-spacing on the basidium as well as with the basic relations between their sizes in order to use these relations as additional species and generic criteria in higher Basidiomycetes.

Research continues to develop from the investigations of Corner (1972), requiring a study of side and end positions of spores on basidia. To study basidia for geometrical dependencies, clear, accurate photographs of the end and side positions at high magnification showing spore-spacing on the basidia are necessary. Since the basidium cannot be examined simultaneously both in end-view and in side-view, it follows that average parameters must be taken from a set of measurements for each species (from 100 up to 1000), *i.e.*, the data for the "ideal" basidium are obtained.

As most higher Basidiomycetes have four spores on the basidium, the tetrad is considered to be a unit (n=4). The four spores in end-view are considered the angles of a square.* One can imagine the spores located in the square angles to be confined by an outer circle S' (FIG. 1a, 1b), a central circle S'' passing through the centers of the spores and an inner circle S'''. Then there is the real basidium circle (w), the diameter of which equals its maximal width. For the sterigmata, one can imagine a sterigmatic circle (M), passing through the tips of the sterigmata and the sterigmatic patch circle (m) which equals the sterigmata diameter.

Taking into account the law on the forces of electric regulation of free surfaces, this paper is based on the following postulates:

1. Adjacent basidia affect the position of basidiospores.
2. Spore tetrads are not contiguous.
3. Spores in a tetrad are not contiguous but separated from the basidium by sterigmata.
4. Spores of a basidium are at the same level.
5. Spores in a tetrad are arranged uniformly, *i.e.*, at

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* If n=3 or n=5 the spores in end-view are considered, respectively, as the angles of an equilateral triangle or of a pentagon.

the same distance from each other.

6. Mature basidia are separated from each other by the maturing basidia and cystidia.

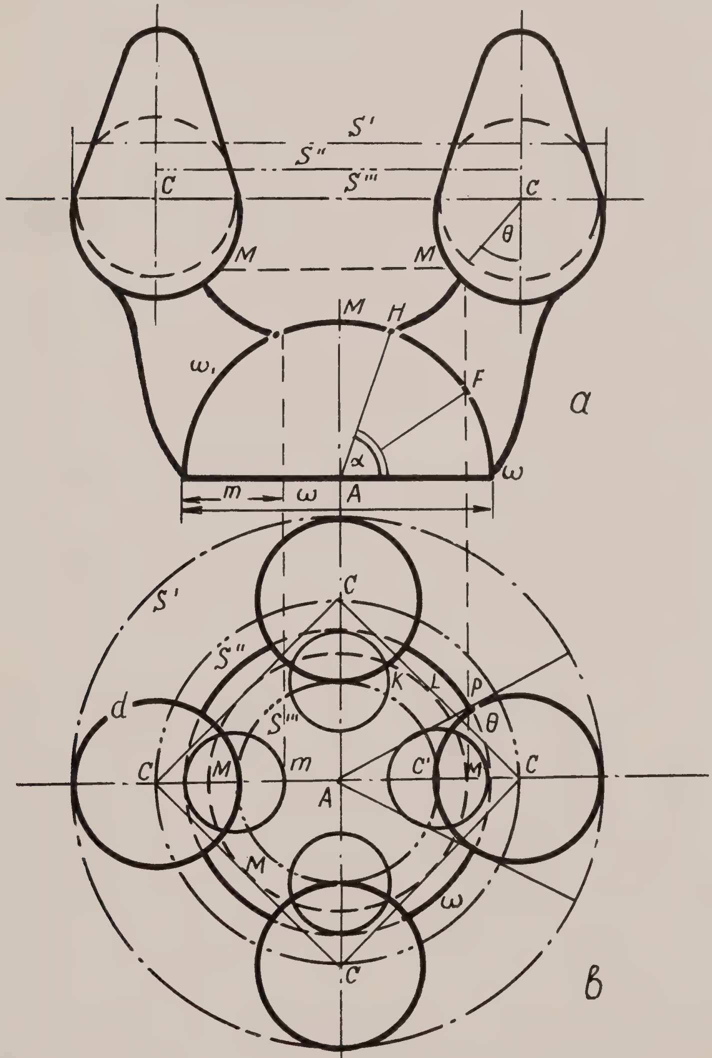
S'
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FIG. 1. Geometry of the basidium: a) side-view; b) end-view.

THE GEOMETRY OF THE BASIDIUM

Proceeding from numerous observations, a set of measurements and derivation of averages, it was established that the reciprocal position of sterigmata and spores on the basidium is subject to a scheme which is given in FIG. 1a, 1b (Corner, 1972). We have adopted Corner's designations in this paper to unify our observations.

Let us consider FIG. 1b, the end-view of the basidium:

d - the outline of the spore (the circle with the diameter d);
w - the outline of the basidium (the circle with the diameter w);
S'' - the central circle (the circle with the diameter S'' passing through the centers of the outlines of the spores);
S' - the outer circle (the circle with the diameter S', embracing the spores outlines, *i.e.*, externally tangential to them);
S''' - the inner circle (the circle with the diameter S''' limiting the "dead space" over the basidium, *i.e.*, the circle internally tangential to the spores outlines);

Obviously, then

$$S' = S'' + d \qquad (1)$$

$$S''' = S'' - d \qquad (2)$$

whence $S' + S''' = 2S''$, $\quad S' - S''' = 2d \qquad$ (3), (4)

δ - the angle between the axis AC and tangential to the spore outline;

$$\sin\delta = \frac{\mathrm{PC}}{\mathrm{AC}} = \frac{2\mathrm{PC}}{2\mathrm{AC}} = \frac{d}{S''} \qquad (5)$$

M - the sterigmata circle (the circle with the diameter M passing through the sterigma tips); numerous measurements of Corner (1972) showed that

$$M = S'' - 0.7d \qquad (6)$$

m - sterigmata patch (the circle of diameter m which is a projection of the sterigmata base). By the hypothesis of Corner the circle m is inside the circle w being tangential to the circle w and straight line AP, *i.e.*,

$$m = S''' \cdot \sin\delta = d(1 - \sin\delta) \qquad (7)$$

and the center C' of the circle m lies on the circle S''', whence

$$w = S''' + m = S'''(1 + \sin\delta) \qquad (8)$$

$\overline{\mathrm{CC}}$ - a segment connecting the spore circles centers; K and L - transverse points of this segment with the spores outlines;

$\overline{\mathrm{KL}}$ - the shortest distance between the spores;

θ - the angle of the spore (the angle $\angle\mathrm{CLM}$).

Let us now consider FIG. 1a,* the side view of the basidium.

w_1 - outline of the basidium-apex. According to Corner (1972) the basidium-apex is an ellipsoid with a small spherical dome. Therefore w_1 is an oval. Since prior to formation of a hyaline "cap" the basidium has a hemisphaerical apex, then in subsequent calculations the semicircle with the diameter w is taken approximately as the w_1 outline.

$\smile \mathrm{HF}w$ - the arc on the outline of w_1 which limits the sterigmata base;

α - the central angle, corresponding to the arc $\mathrm{HF}w$.

It follows from the diagram that

$$\cos\alpha = \frac{S''' - m}{w} \qquad (9)$$

or after the substitution (8)

$$\cos\alpha = \frac{S''' - m}{S''' + m} \qquad (10)$$

The line M-M, projecting the sterigma circle M, crosses the arc Hw at the point F, dividing this arc into two parts (Corner, 1972), *i.e.*,

$$\underline{\lfloor w\mathrm{AF}} = \frac{\alpha}{2}\text{ , whence}$$

$$M = w\cdot\cos\frac{\alpha}{2} = w\sqrt{\frac{1 + \cos\alpha}{2}} \qquad (11)$$

The coefficient σ is introduced for the characteristic of spore position in the tetrad (Corner, 1972) which equals the ratio of the shortest distance between the spores, *i.e.*,

$$\sigma = \frac{\mathrm{KL}}{\mathrm{CK} + \mathrm{LC}} = \frac{\mathrm{KL}}{d} \qquad (12)$$

Subsequently on the basis of (1) - (12) and the geometry of FIG. 1a, 1b, formulae are derived which determine the parameters of the basidium as functions σ, δ and α (TABLE I). By means of these formulae different geometrical ratios between the tetrad parameters may be deduced. In Corner's (1972) work, on the basis of the formulae in TABLE I, one obtains

$$\frac{S'}{S''} = 1 + \sin\delta \qquad (13)$$

$$\frac{S'''}{S''} = 1 - \sin\delta \qquad (14)$$

$$\cos\alpha = \frac{S'''}{S'} \qquad (15)$$

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* Only two extreme sterigmata with the spores are shown for the purpose of reading the diagram in FIG. 1a.

TABLE I

FORMULAE DETERMINING PARAMETERS OF THE BASIDIUM AS FUNCTIONS σ, δ AND α

Argument / Parameter	σ	δ	α
I	2	3	4
S''	$S'' = d\sqrt{2}\,(1 + \sigma)$ (22)	$S'' = \frac{d}{\sin\,\delta} = d\,\mathrm{cosec}\,\delta$ (23)	$S'' = d\,\frac{1 + \cos\,\alpha}{1 - \cos\,\alpha}$ (24)
S'	$S' = d\sqrt{2}\,(1 + \sigma) + d$ (25)	$S' = d\,\frac{1 + \sin\,\delta}{\sin\,\delta}$ (26)	$S' = \frac{2d}{1 - \cos\,\alpha}$ (28)
		$S' = d\,(1 + \mathrm{cosec}\,\delta)$ (27)	
S'''	$S''' = d\sqrt{2}\,(1 + \sigma) - d$ (29)	$S''' = d\,\frac{1 - \sin\,\delta}{\sin\,\delta}$ (30)	$S''' = 2d\,\frac{\cos\,\alpha}{1 - \cos\,\alpha}$ (32)
		$S''' = d\,(\mathrm{cosec}\,\delta - 1)$ (31)	
M	$M = d[\sqrt{2}\,(1 + \sigma) - 0.7]$ (33)	$M = d\,(\mathrm{cosec}\,\delta - 0.7)$ (35)	$M = 4d\,\frac{\cos\,\alpha}{\sin^2\,\alpha} \cdot \cos\,\frac{\alpha}{2}$ (38)
	$M = d(\kappa - 1)\sqrt{\frac{\kappa + 1}{\kappa}}$,	$M = d \cdot \mathrm{ctg}\,\delta \cdot \cos\,\delta \cdot \sqrt{\frac{1}{1 + \sin\delta}}$ (36)	$M = \frac{2\sqrt{2}\,d \cdot \cos\,\alpha}{(1 - \cos\,\alpha)\sqrt{1 + \cos\,\alpha}}$ (39)
	where $\kappa = \sqrt{2}\,(1 + \sigma)$ (34)	$M = d\left(\frac{1}{\sin\delta} - \sin\delta\right)\sqrt{\frac{1}{1 + \sin\delta}}$ (37)	
m	$m = d\,\frac{\sqrt{2}\,(1 + \sigma) - 1}{\sqrt{2}\,(1 + \sigma)}$ (40)	$m = d(1 - \sin\,\delta)$ (41)	$m = 2d\,\frac{\cos\,\alpha}{1 + \cos\,\alpha}$ (42)
w	$w = d\,\frac{2(1 + \sigma)^2 - 1}{\sqrt{2}\,(1 + \sigma)}$ (43)	$w = d \cdot \mathrm{ctg}\,\delta \cdot \cos\,\delta$ (44)	$w = 4d\,\frac{\cos\,\alpha}{\sin^2\,\alpha}$ (45)
σ	σ	$\sigma = \frac{\mathrm{cosec}\,\delta}{\sqrt{2}} - 1$ (46)	$\sigma = \frac{1 + \cos\,\alpha}{\sqrt{2}\,(1 - \cos\,\alpha)} - 1$ (47)

δ	$\sin\delta = \dfrac{1}{\sqrt{2}\,(1+\sigma)}$ (48)	δ	$\sin\delta = \dfrac{1-\cos\alpha}{1+\cos\alpha}$ (49)
α	$\cos\alpha = \dfrac{\sqrt{2}\,(1+\sigma) - 1}{\sqrt{2}\,(1+\sigma) + 1}$ (50)	$tg^2\dfrac{\alpha}{2} = \sin\delta$ (51) $\cos\alpha = \dfrac{1-\sin\delta}{1+\sin\delta}$ (52)	α
θ	$\sin\theta = \kappa - (\kappa - 1)\sqrt{\dfrac{\kappa+1}{\kappa}}$, where $\kappa = \sqrt{2}\,(1+\sigma)$ (53)	$\sin\theta = \text{cosec}\,\delta - \dfrac{\cos^2\delta}{\sin\delta}\sqrt{\dfrac{1}{1+\sin\delta}}$ (54)	$\sin\theta = \dfrac{(1+\cos\alpha)^2 - 4\cos\alpha\cdot\cos\frac{\alpha}{2}}{\sin^2\alpha}$ (55)

$$\cos\frac{\alpha}{2} = \sqrt{\frac{S''}{S'}} \qquad (16)$$

$$\sin\delta = \frac{S'' - M}{S''\cdot\sin\theta}\text{ , or}$$

$$\sin\theta = \frac{S'' - M}{S''\cdot\sin\delta} = \frac{S'' - M}{d} \qquad (17)$$

whence $$d = \frac{S'' - M}{\sin\theta} \qquad (18)$$

$$M = w\sqrt{\frac{S''}{S'}} = S'''\sqrt{\frac{S'}{S''}} \qquad (19)$$

$$w = \frac{S'\cdot S'''}{S''} \qquad (20)$$

$$w\cdot S'' = S'\cdot S''' \qquad (21)$$

DEDUCTION OF NEW RATIOS BETWEEN THE BASIDIUM PARAMETERS

Let us, however, note that the coefficient $\sigma\frac{KL}{d}$ introduced in Corner's (1972) work is not convenient from the point of view of carrying out measurements, as it calls for measurement of the segment KL, which is difficult to realize in practice. Besides, use of σ as an argument results in complex formulae for determining the parameters of the basidium (see TABLE I).

Proceeding from this, let us introduce the following coefficients:

a) for characteristics of spore distribution on the basidium we shall use the coefficient n, which is equal to the ratio of the central circle diameters and the spore outline, *i.e.*,

$$n = \frac{S''}{d}$$

b) for determining the ratios between the basidium parameters we shall introduce the coefficient q, which is equal to the ratio of the outer circle diameters and the basidium outline, *i.e.*,

$$q = \frac{S'}{w}$$

The main peculiarity of these coefficients is the simplicity of measuring all the constituent values as well as using the "real" outlines d and w, *i.e.*, the outlines easily observable and measurable under the microscope and on basidium photographs.

On the basis of these coefficients we obtain new formulae for determination of all geometrical parameters of the basidia (TABLE II).

TABLE II

FORMULAE DETERMINING GEOMETRICAL PARAMETERS OF THE BASIDIUM AS FUNCTIONS n AND q

Argument Parameter	n		q	
S''	$S'' = d\cdot n$	(56)	$S'' = d\,\frac{q}{q-1}$	(57)
S'	$S' = d(n+1)$	(58)	$S' = w\cdot q = d\,\frac{2q-1}{q-1}$	(59)
S'''	$S''' = d(n-1)$	(60)	$S''' = \frac{d}{q-1}$	(61)
M	$M = d(n-1)\sqrt{\frac{n+1}{n}}$	(62)	$M = \frac{d}{q+1}\sqrt{\frac{2q-1}{q}}$	(63)
m	$m = d\,\frac{n-1}{n}$	(64)	$m = \frac{d}{q}$	(65)
w	$w = d\,\frac{n^2-1}{n}$	(66)	$w = d\,\frac{2q-1}{q(q-1)}$	(67)
$\sin\delta$	$\sin\delta = \frac{1}{n}$	(68)	$\sin\delta = \frac{q-1}{q}$	(69)
$\cos\alpha$	$\cos\alpha = \frac{n-1}{n+1}$	(70)	$\cos\alpha = \frac{1}{2q-1}$	(71)
$\sin\theta$	$\sin\theta = n-(n-1)\sqrt{\frac{n+1}{n}}$	(72)	$\sin\theta = \frac{q-\sqrt{\frac{2q-1}{q}}}{q-1}$	(73)
n	n		$n = \frac{q}{q-1}$	(74)
q	$q = \frac{n}{n-1}$	(75)	q	

The simplicity of the formulae obtained permits easily finding new ratios between the basidial parameters. For example, from (65) we have $q = \frac{d}{m}$ and from (57) and (61) we obtain $q = \frac{S''}{S'''}$, *i.e.*, $q = \frac{S}{w} = \frac{S''}{S'''} = \frac{d}{m}$ (76)

whence the following properties of basidia are formulated:

1. The ratio of the outer circle and basidium outline diameters is equal to the ratio of the central and inner circles diameters and also to the ratio of the spore outline and sterigmatic patch diameters.

2. The ratio of the central and inner circles diameters is equal to the ratio of the spore outline and sterigmatic patch diameters.

3. The ratio of the central circle and spore outline diameters is equal to the ratio of the inner circle and sterigmatic patch diameters.

The coefficient n may also be expressed by the product of ratios of sterigmatic circle, basidium outline and sterigmatic patch diameters in a form

$$n = \frac{M}{w} \cdot \frac{M}{m} \qquad (77)$$

which follows from formulae (62), (64) and (66). And from (77) and (19)

$$n = \frac{w}{m} \cdot \frac{S''}{S'}\ , \quad \text{or} \quad n = \frac{S'''}{m} \cdot \frac{S'''}{w} \cdot \frac{S'}{S''} \qquad (78),\ (79)$$

From (74) and (75) it follows:

$$\frac{1}{n} + \frac{1}{q} = 1 \qquad (80)$$

4. The sum of the values which are inverse to the coefficients n and q is equal to 1.

If in (80) we substitute n and q by their values according to (76), (77), etc., we shall obtain a set of new ratios among the basidial parameters. Thus, using functional dependencies represented in TABLE II, we can obtain new ratios, such as (76) - (80) as well as

$$\frac{S'}{d} = \frac{w}{m}\ ; \quad \frac{S'}{w} = \frac{S''}{S'''}\ ; \quad M^2 = w \cdot S'' \qquad (81),\ (82),\ (83)$$

and others, each of them expressing a definite geometrical property of the basidia.

Consequently the study of basidial geometry permits determining many of their properties by simple mathematical operations accessible to the mycologist who has forgotten the elements of higher mathematics.

DETERMINATION OF THE BASIDIAL PARAMETERS

Let us determine the parameters of the basidium in the function n. The limits of measuring n we shall establish from 1.5 to 5.0 as n is the value inverse to sin δ and the angle δ can change within the limits of 45°-10° according to Corner (1972).

1. For determining S', S'', S''' we shall use formulae (56), (58) and (60). These values may also be found graphically, as is demonstrated in FIG. 2. Let us draw the number

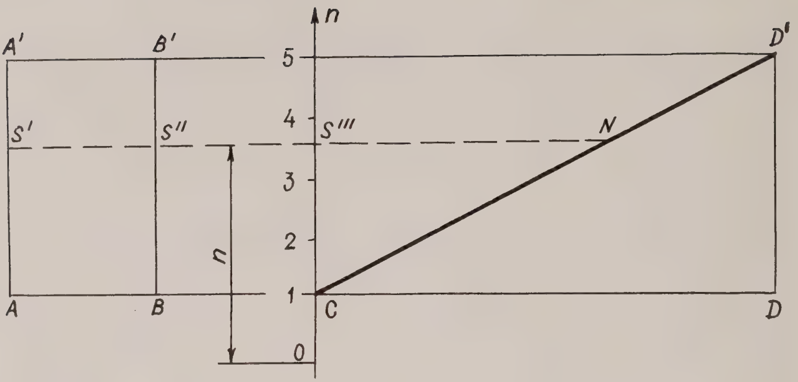

FIG. 2. Graphic plotting for determination of S', S'', S'''.

axis n and in the selected design scale from the point C on the mark $n=1$ lay the segments CB=d, CA= $2d$ and CD=$4d$. Through the points obtained, A, B and D, draw the vertical straight line up to the mark $n=5$. Connect the points C and D'. If we lay the arbitrary value n from 0 and draw a horizontal straight line, its intersection with the straight lines AA', BB' and CD' will determine the segments $NS'''=S'''$, $NS''=S''$, $NS'=S'$.

2. The value m is determined according to formula (64). Graphic determination of m is shown in FIG. 3. Let us draw the number axis n and in the selected scale of the design construct the isosceles right triangle CAB in such a way that $\overline{CA}=\overline{AB}=d(\overline{OC}=1)$. If we lay from 0 the arbitrary value $n(ON=n)$ and draw the straight line CN, its intersection with the straight line AB determines the segment $\overline{BN''}=m$.

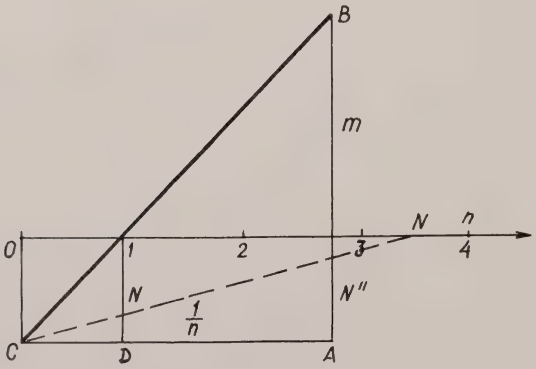

FIG. 3. Graphic plotting for determination of m and sin δ.

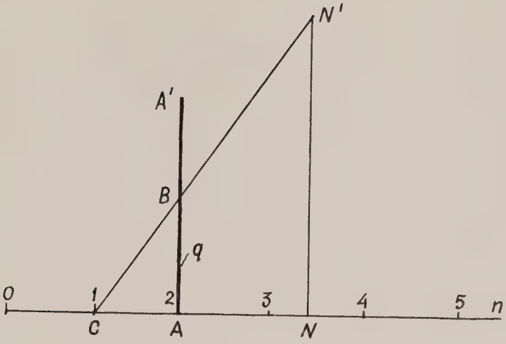

FIG. 4. Graphic plotting for determination of *M*.

3. The value of sin δ is determined according to formula (68). The preliminary plotting may also be used for graphic determination of sin δ. The straight line CN (FIG. 3) crosses the vertical straight line ID at the point N' in such a way that $\overline{DN'}$ = sin δ.

4. It is convenient to determine the value w according to formula (8). Under these conditions w is determined graphically by the simple addition of the segments S''' and m, *i.e.*, if we lay the sections AD=S''' and DC=m, the segment AC=w (FIG. 4).

5. FIG. 4 shows graphic determination of the value *M*. Lay AB=S''' and construct the semicircle on the segment BC, as on the diameter. Its intersection with the vertical straight line AM will determine the segment $\overline{AM}$=m. This corresponds to the determination of the value *M* according to formula (83).

6. The value q is determined by formula (75). Its graphic determination is shown in FIG. 5. The points C($\overline{OC}$=1), A($\overline{OA}$=2) are marked on the number axis n and the vertical straight line AA' is drawn. If we lay the arbitrary segments ON=NN'=n, the straight lines AA' and CN' cross at point B in such a way that AB=q.

7. Graphic determination of cos α is shown in FIG. 6a, 6b.

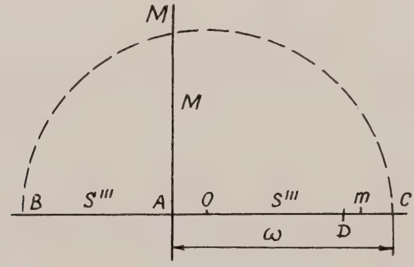

FIG. 5. Graphic plotting for determination of q.

TABLE III

NUMERICAL VALUES OF THE BASIDIAL PARAMETERS IN FUNCTION d AND n

n	S'	S''	S'''	m	$\sin\delta$	δ	w	M	q	$\cos\alpha$	α	$\sin\theta$	θ
1.5	2.5d	1.5d	0.5d	0.3333d	0.6666	$41^\circ 48'$	0.8333d	0.645d	3.0000	0.2000	$78^\circ 29'$	0.855	$58^\circ 46'$
1.6	2.6d	1.6d	0.6d	0.3750d	0.6255	$38^\circ 42'$	0.9750d	0.965d	2.6666	0.2308	$76^\circ 39'$	0.835	$56^\circ 37'$
1.7	2.7d	1.7d	0.7d	0.4118d	0.5881	$36^\circ 1'$	1.1180d	0.885d	2.4285	0.2593	$74^\circ 58'$	0.815	$54^\circ 36'$
1.8	2.8d	1.8d	0.8d	0.4444d	0.5555	$33^\circ 45'$	1.2444d	0.999d	2.2500	0.2857	$73^\circ 24'$	0.801	$53^\circ 14'$
1.9	2.9d	1.9d	0.9d	0.4737d	0.5263	$31^\circ 45'$	1.3737d	1.120d	2.1111	0.3103	$71^\circ 53'$	0.780	$51^\circ 18'$
2.0	3.0d	2.0d	1.0d	0.5000d	0.5000	30°	1.5000d	1.225d	2.0000	0.3333	$70^\circ 32'$	0.775	$50^\circ 48'$
2.5	3.5d	2.5d	1.5d	0.6000d	0.4000	$23^\circ 35'$	2.1000d	1.770d	1.6666	0.4286	$64^\circ 37'$	0.730	$46^\circ 54'$
3.0	4.0d	3.0d	2.0d	0.6666d	0.3333	$19^\circ 28'$	2.6666d	2.308d	1.5000	0.5000	60°	0.692	$43^\circ 48'$
3.5	4.5d	3.5d	3.5d	0.7143d	0.2857	$16^\circ 36'$	3.2143d	2.830d	1.4000	0.5555	$56^\circ 15'$	0.670	$42^\circ 40'$
4.0	5.0d	4.0d	3.0d	0.7500d	0.2500	$14^\circ 28'$	3.7500d	3.354d	1.3333	0.6000	$53^\circ 6'$	0.646	$40^\circ 15'$
4.5	5.5d	4.5d	3.5d	0.7777d	0.2222	$13^\circ 50'$	4.2777d	3.871d	1.2857	0.6364	$50^\circ 29'$	0.629	$38^\circ 58'$
5.0	6.0d	5.0d	4.0d	0.8000d	0.2000	$11^\circ 32'$	4.8000d	4.380d	1.2500	0.6666	$48^\circ 12'$	0.620	$38^\circ 19'$

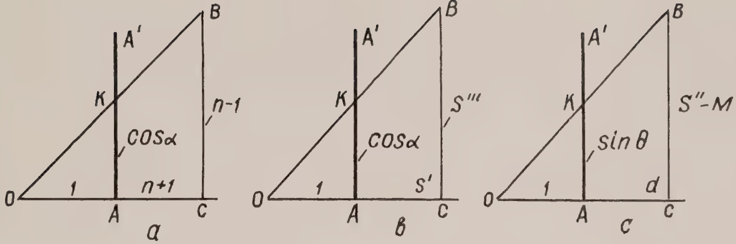

FIG. 6. Graphic plotting for determination of cos α (a, b) and sin θ (c).

In the design scale we construct the right triangle OBC in such a way that $OC=n+1$, $BC=n-1$ (FIG. 6a), and through the point A($\overline{OA}$=1) draw the vertical straight line AA'. The intersection of this straight line with the hypotenuse of the triangle determines the point K in such a way that $\overline{AK}=\cos\alpha$ according to formula (70). Under these conditions the segments OC and BC must be laid equal to $OC=S'$, $BC=S'''$ (FIG. 6b).

8. If in the preliminary plotting we lay the segments $OC=d$ and $BC=S''-M$ (FIG. 6c), the intersection of the hypotenuse of triangle OBC with the straight line AA' will determine the segment $AK=\sin\theta$. This plotting corresponds to the determination of sin θ according to formula (17). The numerical values of the basidial parameters in the function d and n are presented in TABLE III.

CONCLUSION

The investigations carried out show that the introduction of the mathematical apparatus opens interesting and reassuring prospects for studying the basidia of higher Basidiomycetes on the basis of geometrical dependencies and, in particular, in opening a number of new parameters having specific and generic implications. The task of further investigations is to determine the application of the established ratios for the ideal basidium as criteria of species, genus and, probably, family in a great number of representatives of higher Basidiomycetes.

LITERATURE CITED

CORNER, E.J.H. 1947. Variation in the size and shape of spores, basidia and cystidia in Basidiomycetes. *New Phytol.* 46: 195-228.

CORNER, E.J.H. 1948. Studies in the basidium. I. The ampoule effect, with a note on nomenclature. *New Phytol.* 47: 22-51.

CORNER, E.J.H. 1950. A monograph of *Clavaria* and allied genera. *Ann. Bot. Mem.* 1: 1-740.

CORNER, E.J.H. 1968. A monograph of *Thelephora* (Basidiomycetes). *Beih. Nova Hedwigia* 27: 1-110.

CORNER, E.J.H. 1972. Studies in the basidium: spore-spacing and the *Boletus* spore. *Gard. Bull. Straits Settlem. (Singapore)* 26: 159-192.

MALENÇON, G. 1958. Le développement des spores chez les Phylactériés.

Bull. Soc. Mycol. France 74: 423-435.

PERREAU-BERTRAND, J. 1967. Recherches sur la différenciation et la structure de la paroi sporale chez les Homobasidiomycètes à spores ornées. *Ann. Sci. Nat. Bot.* sér. 12, 8: 639-745.

MYCOTAXON

Vol. X, No. 2, pp. 365-368 January-March 1980

Absconditella duplicella and *Cryptodiscus rutilus*: Additions to the Ostropalean Fungi

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During a recent study of *Calonectria* type specimens, two species were found to be related to the ostropalean fungi. These were transferred without descriptions to more appropriate genera in a preceding publication (Rossman, 1979). As yet, these species are known only from the type specimens. Because the specimens are scanty, descriptions and illustrations of *Absconditella duplicella* and *Cryptodiscus rutilus* are given below.

ABSCONDITELLA DUPLICELLA (Nyl.) Rossm., Mycotaxon 8:505. 1979. Figure 1.
≡ *Calonectria duplicella* (Nyl.) Karst., Bidrag. Kännedom Finlands Natur Folk 23:218. 1873.
≡ *Sphaeria duplicella* Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 10:89. 1868.

Holotype: Finland. In Lapponia orientali extrema, ad Ponoi, supra caespites Jungermanniarum, N. I. Fellman. (H). Additional isotype slides deposited at FH.

ASCOCARPS scattered, solitary, sessile, superficial on bleached, matted area about 1 cm^2, without evident lichen thallus, apothecioid, fleshy, doliform with raised margins, 190-270 μm diam x 160-250 μm tall, ascocarp margins white, sunken hymenial disc orange.

ASCOCARP MARGIN 45-50 μm wide, non-crystalline, composed of cells forming textura intricata, cells 1.5 μm diam, cells compact in middle becoming more loosely intertwined toward margin; subhymenium 15-20 μm thick, composed of irregularly-shaped cells, up to 5 μm diam, forming textura angularis.

PARAPHYSES numerous, filiform, unbranched, hooked at apices, about 1 μm diam, nonseptate, exceeding asci in length by about 10 μm, slightly inflated near apical 7-10 μm, up to 2 μm wide, apices clavate or tapering to rounded ends.

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ASCI unitunicate, cylindric to slightly obclavate, 90-110 x 19-21 µm, with distinctly thickened apices, up to 7.5 µm thick in immature asci, I-, asci arising in an even layer from basal tissue.

ASCOSPORES broadly clavate-fusiform with rounded ends, 40-44 x 8-10 µm, 3-, rarely 4-, septate, slightly constricted at each septum, hyaline, smooth, thin-walled, 2 or 4 per ascus, overlapping monostichous.

This species has asci each with a thickened apex characteristic of the Ostropales. *Absconditella duplicella* does not have a distinct lichen thallus, but based on all other characters, it is best placed in the lichen genus *Absconditella*. Although included in the Gyalectaceae by Vězda (1965), Sherwood (1977) suggests that "*Absconditella* is strikingly similar to *Cryptodiscus* and is accepted as Ostropalean...". The type of the genus, *Absconditella sphagnorum* Vězda & Poelt, occurs on moss and has a poorly developed thallus. Unlike *A. sphagnorum* and other species of *Absconditella, A. duplicella* lacks a thallus and has ascocarps which become completely superficial at maturity. In addition, the ascospores of *A. duplicella* are multiseptate and larger than those of *A. sphagnorum*.

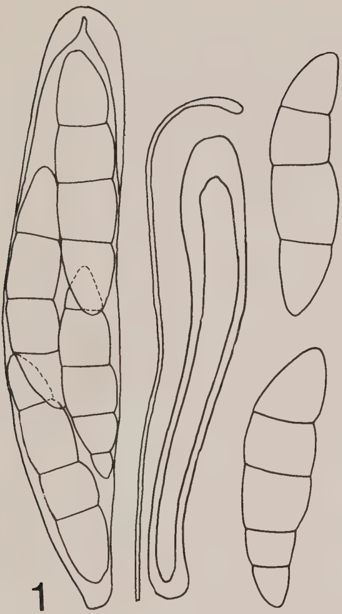
CRYPTODISCUS RUTILUS (Kirschst.) Rossm., Mycotaxon 8:541. 1979. Figure 2.
≡ *Calonectria rutila* Kirschst., Ann. Mycol. 37:116. 1939.

Holotype: Germany. Wald bei Rathenow. a. d. H. Auf morschem Kieferholz. (B). Isotype slides deposited at NY.

ASCOCARPS scattered, solitary, at first completely immersed, becoming erumpent and eventually almost entirely superficial with only the base immersed, apothecioid, when immature, closed, appearing perithecioid, small, 250-305 µm diam, about 110 µm tall, red-orange to orange, becoming scarlet on drying.

ASCOCARP MARGIN 25-40 µm becoming narrower at base, raised, slightly scurfy externally but non-crystalline, composed of small, indistinct cells forming textura angularis, tissue immediately surrounding the hymenium orange, pigmentation apparently part of cytoplasm, cells walls only slightly thickened, up to 0.5 µm, outermost layer of cells hyaline.

PARAPHYSES numerous, filiform, unbranched, 0.5-0.5 µm diam, nonseptate, often inflated up to 2 µm diam at apex.



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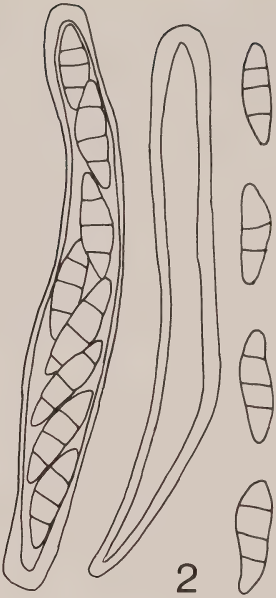

2

Figure 1. *Absconditella duplicella* ascus, paraphysis, immature ascus, and ascospores. 1000 x. Figure 2. *Cryptodiscus rutilus* ascus, immature ascus, and ascospores. 1000 x.

ASCI unitunicate, cylindric to slightly obclavate, 56-68 x 6-8 µm, with apices thickened, up to 5 µm, and penetrated by a narrow pore in immature asci, I-, walls of asci thickened about 2 µm at maturity and remaining so after spore discharge, asci arising in an even layer from basal tissue.

ASCOSPORES ovoid-ellipsoid, 12-16 x 4-5 µm, distinctly 2- to 3-septate, not constricted at each septum, hyaline, smooth, thin-walled, eight spores per ascus, monostichous but sometimes distichous toward base of ascus.

The holotype specimen consists of one piece of very rotten, decorticated pine wood. Numerous small ascocarps of *Cryptodiscus rutilus* are present. The apothecial margin encloses the hymenium of immature ascocarps thus they appear perithecioid. The thickened ascal apex is penetrated by a narrow pore when immature suggesting placement in the Ostropales. Although all other species of *Cryptodiscus* are almost completely immersed in the substrate, even at maturity, *C. rutilus*, with ascocarps which become superficial, is best accommodated in this genus.

I am greatly indebted to Dr. Martha A. Sherwood for her advice concerning the placement of these species. In addition I wish to thank Dr. Burghard Hein, Botanischer Garten und Botanisches Museum, Berlin-Dahlem, and the Director and Staff, Botanical Museum, University of Helsinki, for the generous loan of type specimens.

Rossman, A. 1979. Mycotaxon 8:485-558. A preliminary account of the taxa described in *Calonectria*.

Sherwood, M. 1977. Mycotaxon 5:1-277. The ostropalean fungi.

Vězda, A. 1965. Preslia 37:237-245. Flechtensystematische Studien II. *Absconditella*, eine neue Flechtengattung.

MYCOTAXON

Vol. X, No. 2, pp. 369-371 January-March 1980

FILAMENTOUS FUNGI ASSOCIATED WITH LEAF SURFACES OF RED ALDER AND DOUGLAS FIR SEEDLINGS IN WESTERN OREGON

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During a study of the effects of ozone on leaf-surface microorganisms of red alder [*Alnus rubra* Bong.] and Douglas fir [*Pseudotsuga menziesii* (Mirb.) Franco] seedlings, many species of filamentous fungi were isolated and identified. No other study of red alder leaf-surface fungi has been made. Douglas fir needle-surface fungi were examined *in situ* by Bernstein & Carroll (1973) and Sherwood & Carroll (1974). Using cultural techniques the endophytic fungi of conifer needles including Douglas fir have been enumerated by Bernstein & Carroll (1977), Carroll, *et al.* (1977) and Carroll & Carroll (1978). Most of the fungi listed below have not been previously reported from this habitat.

Filamentous fungi were isolated from leaf surfaces of two year Douglas fir seedlings obtained from a local nursery and two year red alder seedlings which had been transplanted from their natural habitat. All plants were grown in chambers through which ozone was continuously blown at concentrations of 0, 5, 10 and 20 parts per hundred million. Red alder was sampled monthly throughout the growing season from 3 May 1975-3 November 1975 while Douglas fir was sampled from 3 May 1975-13 January 1976. Although both first and second year needles were used in the study, this age difference was not considered significant at the time and the data were pooled. Fresh tissue was washed twice in 0.1% Tween 20 and rinsed in sterile water. Serial dilutions of wash water were incorporated into Cooke Rose Bengal agar (Difco-Bacto), 2% malt agar (Difco-Bacto) and 2% soil extract agar (Difco-Bacto made with 500 ml water percolated through 75 g forest soil). Washed leaves (4 mm^2) and whole needles were placed on the same three kinds of media. After ten days filamentous fungi were subcultured, as they grew through the agar or from the tissue, and identified.

The following list of filamentous fungi is presented as base data for future work on the effects of air pollutants on the phyllosphere flora. Table I lists the filamentous fungi associated with leaf surfaces either actively or inactively as resting propagules. *Aureobasidium pullulans* was isolated most frequently from both red alder and Douglas fir, often occurring on 100% of the samples. All species listed were isolated at least twice. No attempt was made to identify the *Penicillium* species; many isolates produced only sterile mycelium.

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TABLE I.

	Red Alder	Douglas Fir
Acremonium strictum W. Gams	X	-
Alternaria alternata (Fr.) Keissler	X	X
Arthrinium arundinis (Corda) Dyko & Sutton	X	-
Aspergillus clavatus Desm.	-	X
A. niger Van Tiegh	X	X
**Aureobasidium pullulans* (De Bary) Arnaud	X	X
Botrytis cinerea Pers. ex Pers.	X	X
Chaetomium cochliodes Palliser	X	-
C. elatum Kunze ex Fr.	-	X
C. funicolum Cooke	X	X
Cladobotryum verticillatum (S. F. Gray) Hughes	-	X
**Cladosporium cladosporioides* (Fresen) De Vries	X	X
**C. herbarum* (Pers.) Link ex S. F. Gray	X	X
C. macrocarpum Preuss.	X	X
**C. oxysporum* Berk. & Curt.	X	X
C. sphaerospermum Penz.	X	X
Curvularia lunata (Wakker) Boedijn	X	-
Cylindrocarpon obtusisporum (Cooke & Hark.) Wollenw.	-	X
Dinemasporium sp.	-	X
Emericella nidulans (Eidam) Vuill.	X	-
**Epicoccum purpurascens* Ehrenb. ex Schlecht.	X	-
Fusarium arthrosporioides Sherb.	X	-
F. tabacinum (Beyma) W. Gams	-	X
Gelasinospora tetrasperma Dowding	X	-
Gelatinosporium sp.	-	X
Geniculisporium sp.	X	-
Gliosporium sp.	X	-
Humicola fuscoatra Traaen	X	X
**Khuskia oryzae* Hudson	-	X
Melanconium sp.	-	X
Memnoniella echinata (Riv.) Falloway	X	X
Monocillium sp.	X	-
Monodictys castaneae (Wallr.) Hughes	-	X
Monodictys sp.	X	-
Monochaeta sp.	-	X
Mortierella ramanniana (Moel.) Linn. var. *angulispora* (Naumov) Linnemann	X	X
Nodulisporium sp.	X	X
Neurospora sitophila Shear & Dodge	X	-
Penicillium spp.	X	X
Pestalotia cfr. *clavispora* Atk.	-	X
P. microspora Sacc.	X	-
P. vaccinii (Shear) Guba	-	X
Phialophora hoffmannii (Beyma) Schol-Schwarz	X	X
P. verrucosa Medlar	X	-
Phoma glomerata (Corda) Wollenw. & Hochapf.	-	X
P. herbarum Westend.	-	X

Table I. (continued)

	Red Alder	Douglas Fir
Rhizopus sp.	-	X
Scopulariopsis asperula (Sacc.) Hughes	X	-
S. brevicaulis (Sacc.) Bain.	X	X
S. brumptii Salvanet-Duval	X	-
Scytalidium lignicola Pesante	X	X
Selenophoma sp.	-	X
Septonema chaetospira (Grove) Hughes	-	X
Sordaria fimicola (Roberge) Ces. & De Not.	-	X
S. minima Sacc. & Speg.	-	X
Stephanosporium ceralis (Thüm.) Swart	-	X
Talaromyces luteum (Zukal) Benj.	X	-
Trichocladium asperum Harz	X	-
Trichoderma viride Pers. ex Fr.	X	-
Trichothecium roseum Link ex Fr.	X	X
**Ulocladium botrytis* Preuss.	X	X
U. chartarum (Preuss.) Simmons	X	X
Varicosporium sp.	-	X

*Previously reported to occur on Douglas fir needle surfaces (Sherwood & Carroll, 1974).

Acknowledgements

This project was financed in part with federal funds from the United States Environmental Protection Agency under Interagency Agreement No. IAG-D5-F469. The contents do not necessarily reflect the views and policies of the E. P. A., nor does mention of trade names or commercial products constitute endorsement for use.

References Cited

Bernstein, M. E. & G. C. Carroll, 1977. Internal fungi in old-growth Douglas fir foliage. Can. J. Bot. 55:644-653.

Bernstein, M. E., H. M. Howard & G. C. Carroll, 1973. Fluorescence microscopy of Douglas fir foliage epiflora. Can. J. Microbiology 19:1129-1130.

Carroll, G. C. & F. E. Carroll, 1978. Studies on the incidence of coniferous needle endophytes in the Pacific Northwest. Can. J. Bot. 56:3034-3043.

Carroll, R. E., E. M. Müller & B. C. Sutton, 1977. Preliminary studies on the incidence of needle endophytes in some European conifers. Sydowia 29:87-103.

Sherwood, M. A. & G. Carroll, 1974. Fungal succession on needles and young twigs of old-growth Douglas fir. Mycologia 66:499-506.

MYCOTAXON

Vol. X, No. 2, pp. 372-374 January-March 1980

NOTES ON HYPHOMYCETES. XXXIII.
STACHYBOTRYS SPHAEROSPORA SP. NOV. FROM SOUTH AFRCIA

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ABSTRACT

Stachybotrys sphaerospora Morgan-Jones and Sinclair is described and illustrated from a collection made on decorticated wood in South Africa.

INTRODUCTION

During the course of collecting microfungi on decaying decorticated wood at Golden State Highlands National Park, Orange Free State, South Africa, material was obtained of a species of *Stachybotrys* Corda which has subsequently been determined to represent an undescribed taxon. The fungus, which has been isolated in pure culture, resembles *S. chartarum* (Ehrenb. ex Link.) Hughes, the type species, in a number of respects but differs from it in conidium size and morphology.

TAXONOMIC PART

Stachybotrys sphaerospora sp. nov. (Fig. 1).

Coloniae effusae, densae, griseae vel atrae, pilosae. Mycelium in substrato immersum, ex hyphis ramosis, septatis, hyalinis vel pallide brunneis, laevibus, 1-2.5µm crassis compositum. Conidiophora macronemata, mononemata vel laxe intertexta, erecta, flexuosa, ramosa, septata, cylindrica, laevia vel minute verruculosa, pallide brunnea vel olivaceo-brunnea, usque ad 250µm longa, 2.5-3µm crassa. Cellulae conidogenae phialidicae, discretae, terminales, determinatae, 6 - 7 in verticillo disposae, obovatae, pallide brunneae, leviae vel minute verruculosae, 9-10 X 2.5-5µm. Conidia enteroblastica, sphaerica, nonseptata, atrobrunnea vel atra,

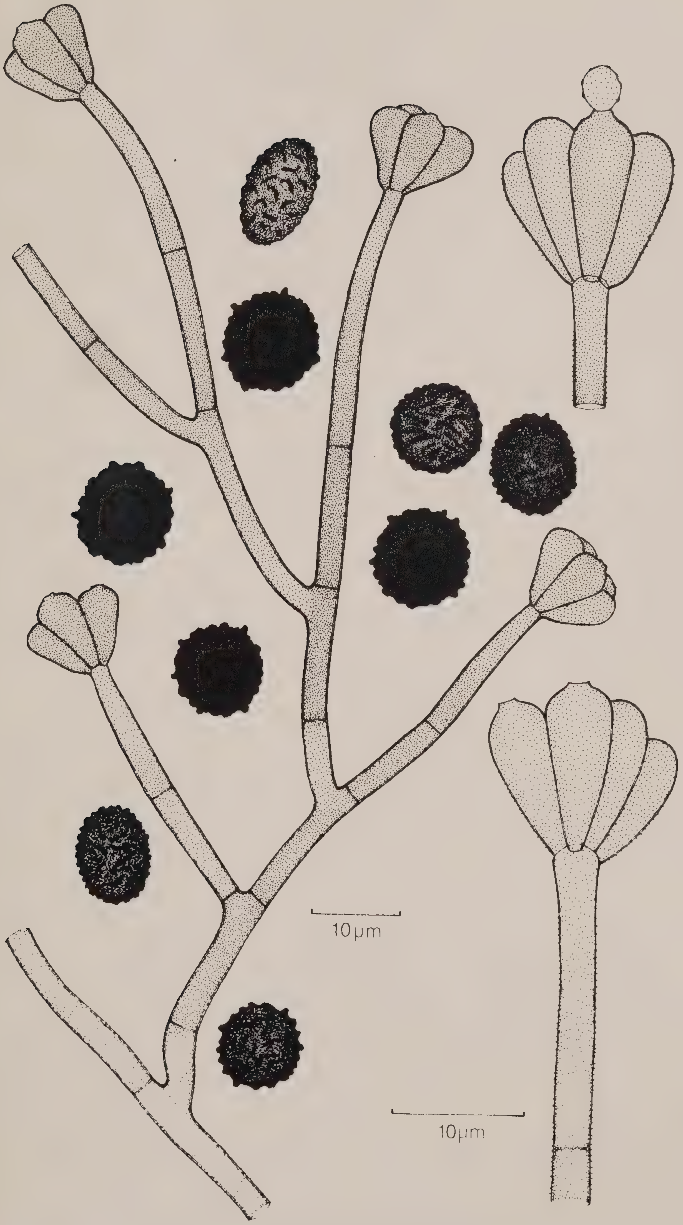

FIGURE 1. *Stachybotrys sphaerospora*

irregulariter porcata, 11-12μm diam.

In lignis putredinis, Golden Gate Highlands National Park, Orange Free State, South Africa, March 14, 1979, R.C. Sinclair, AUA, holotypus.

Colonies effuse, dense, grey to black, hairy. Colonies on PDA extremely thin, slow growing, colourless at first, hen becoming park olive green to blackish with the production of abundant conidia. Mycelium immersed in the substratum, composed of branched, septate, hyaline to pale olivaceous brown or pale brown, smooth, 1-2.5μm thick hyphae. Conidiophores macronematous, mononematous but sometimes loosely intertwining, erect, flexuous, abundantly branched, septate, cylindrical, smooth or minutely verruculose, pale brown to olivaceous brown, up to 250μm long, 2.5-3μm wide. Conidiogenous cells phialidic, discrete, terminal, determinate, arranged in a verticil of 6 - 7, obovate, pale brown, smooth or minutely verruculose particularly toward their base, 9-10 X 2.5-5μm. Conidia enteroblastic, at first ellipsoid to oval, spherical when mature, nonseptate, dark brown to black, ornamented by irregular but prominent ridges, 11-12μm in diameter.

On rotten wood; South Africa.

Collection examined: on rotten, decorticated wood, Golden Gate Highlands National Park, Orange Free State, South Africa, March 14, 1979, R.C. Sinclair, AUA, type.

S. sphaerospora is unique in possessing spherical, ridged conidia. In respect of conidium shape at maturity it closely resembles the condition found in *S. microspora* (Mathur and Sankhla) Jong and Davis and *S. nilagirica* Subramanian. In the former, however, the conidia are much smaller [5-6μm in diameter (Jong and Davis, 1976)] and are warty rather than ridged, and in the latter the conidia are much larger (16-20μm in diameter) and tuberculate (Matsushima, 1975). *S. sphaerospora* bears the following similarities to *S. chartarum*: ridged conidium ornamentation, the presence of a short but easily discernible collarette at the phialide apex, and branched conidiophores.

ACKNOWLEDGMENT

Dr. J. Leland Crane, Illinois Institute of Natural Resources, kindly reviewed the manuscript.

REFERENCES

JONG, S.C. and E.E. DAVIS. 1976. Contribution to the knowledge of *Stachybotrys* and *Memnoniella* in culture Mycotaxon 3: 409-485.

MATSUSHIMA, T. 1975. Icones microfungorum a Matsushima lectorum. Kobe. Published by the author.

MYCOTAXON

Vol. X, No. 2, pp. 375-404 January-March 1980

NOTES ON HYPHOMYCETES. XXXIV. SOME MYCOPARASITIC SPECIES.

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ABSTRACT

Thirteen species of mycoparasitic Hyphomycetes that inhabit basidiomycete carpophores are described and illustrated. They include *Arnoldia clavispora* Gray & Morgan-Jones, a new genus and species, four species of *Cladobotryum* Nees ex Steudel, two species of *Mycogone* Link, *Sepedonium mycophilum* (Pers.) Nees, three species of *Sibirina* Arnold, of which two, *S. gamsii* Gray & Morgan-Jones and *S. purpurea* Morgan-Jones, are new, *Verticillium fungicola* (Preuss) Hassebrauk, and the anamorph of *Hypomyces tulasneanus* Plowright.

INTRODUCTION

Among the many substrates that are known to be colonized by fungi are the mycelia and/or fruiting structures of other fungi. Those that utilize other living fungi as a food source, known as mycoparasites, are common in nature, although frequently overlooked. A large and diverse group of mycoparasites is made up of Hyphomycetes many of which are known to inhabit the carpophores of some of the higher fungi.

A survey of mycoparasitic Hyphomycetes occurring on members of the Agaricales and Aphyllophorales in Alabama has yielded collections of fourteen species (Gray, 1979). In a preceeding publication in this series (Morgan-Jones and Gray, 1979) a new species of *Mycogone, M. psilocybina* Morgan-Jones & Gray, collected during the course of this study, was described. In the present publication thirteen further taxa are described and illustrated. Included are three previously undescribed species, one of which is accommodated in a new genus. Descriptions of four species are based on cultures and/or specimens obtained from the American Type Culture Collection and fellow mycologists.

TAXONOMIC PART

Arnoldia gen. nov.

Deuteromycotina, Hyphomycetes.

Coloniae late effusae, albidae vel pallide stramineae, lanosae. Mycelium partim superficiale, partim immersum, ex hyphis ramosis, septatis, hyalinis, laevibus compositum. Conidiophora semimacronemata, mononemata, erecta, recta vel leviter flexuosa, laevia, hyalina, septata, verticillatim vel irregulariter plureis ramosa. Cellulae conidiogenae polyblasticae, sympodiales. Conidia holoblastica, acrogena apice cellularum conidiogenarum oriunda, clavata, hyalina, laevia, 1 ad 2-septata, hilo minuta praedita.

Species typica: *Arnoldia clavispora* Gray & Morgan-Jones.

Colonies broadly effuse, whitish to pale straw-yellow, lanose. Mycelium partly superficial, partly immersed, composed of branched, septate, hyaline, smooth hyphae. Conidiophores semimacronematous, mononematous, erect, straight or slightly flexuous, smooth, hyaline, septate, verticillately or irregularly branched. Conidiogenous cells polyblastic, sympodial. Conidia holoblastic, acrogenous, produced at the apex of the conidiogenous cells, clavate, hyaline, smooth, 1 to 2-septate, with a narrow subtruncate base.

The new genus is named in honour of Dr. G.R.W. Arnold.

Arnoldia clavispora sp. nov. (Fig. 1, Plate 1 G-H).

Coloniae late effusae, albidae vel pallide stramineae, lanosae. Mycelium partim superficiale, partim in substrato immersum, ex hyphis ramosis, septatis, hyalinis, laevibus, 4-9µm crassis compositum. Conidiophora semimacronemata, mononemata, erecta, recta vel leviter flexuosa, laevia, hyalina, septata, verticillatim vel irregulariter plureis ramosa. Cellulae conidiogenae polyblasticae, sympodiales, cylindricae, 40-100 X 4-5µm. Conidia holoblastica, acrogena apice cellularum conidiogenarum oriunda, clavata, hyalina, laevia, 1 ad 2-septata, hilo minuta praedita, 15-33 X 6-8µm.

Ad carposomata Corioli, Chewacla State Park, Lee County, Alabama, March 23, 1978, D.J. Gray, AUA, holotypus.

Colonies broadly effuse, white to pale straw-yellow, thick, lanose. Colonies on PDA spreading up to 22mm per 24h at 25°C. Mycelium partly superficial, partly immersed in the substratum, composed of branched, septate, hyaline, smooth, frequently anastomosing, 4-9µm wide hyphae. Conidiophores semimacronematous, mononematous, erect, straight or slightly flexuous, smooth, hyaline, septate, verticillately or irregularly branched. Conidiogenous cells polyblastic, sympodial, cylindrical, attenuating gradually towards the apex, indeterminate, terminal on the conidiophore or as small lateral branches of the main stipe,

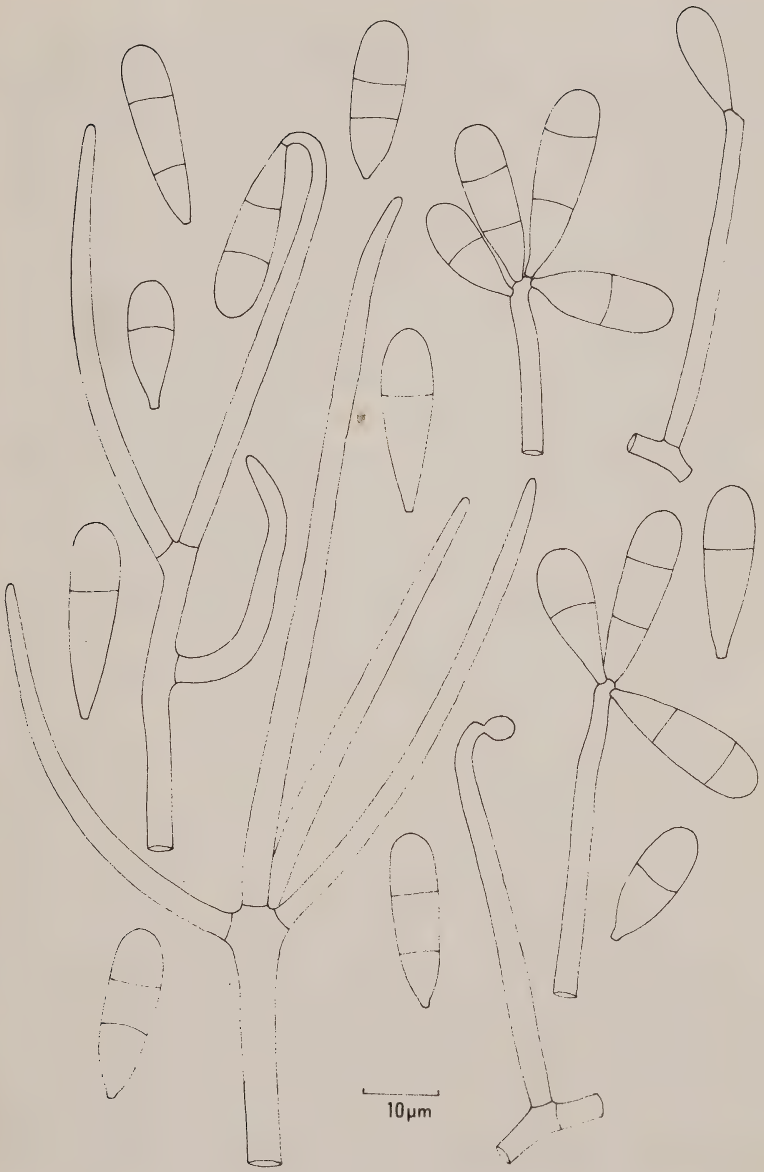


FIGURE 1. *Arnoldia clavispora*

frequently with a somewhat recurved tip as a result of differential wall growth during sympodial proliferation, 40-100 X 4-5µm. Conidia holoblastic, acrogenous, produced at the apex of the conidiogenous cells, clavate, hyaline, smooth, 1 to 2-septate, with a narrow subtruncate base, 15-33 X 6-8µm.

On carpophores of *Coriolus versicolor* (Fr.) Quelet; North America.

Collection examined: on *C. versicolor*, Chewacla State Park, Lee County, Alabama, March 23, 1978, D.J. Gray, AUA, type.

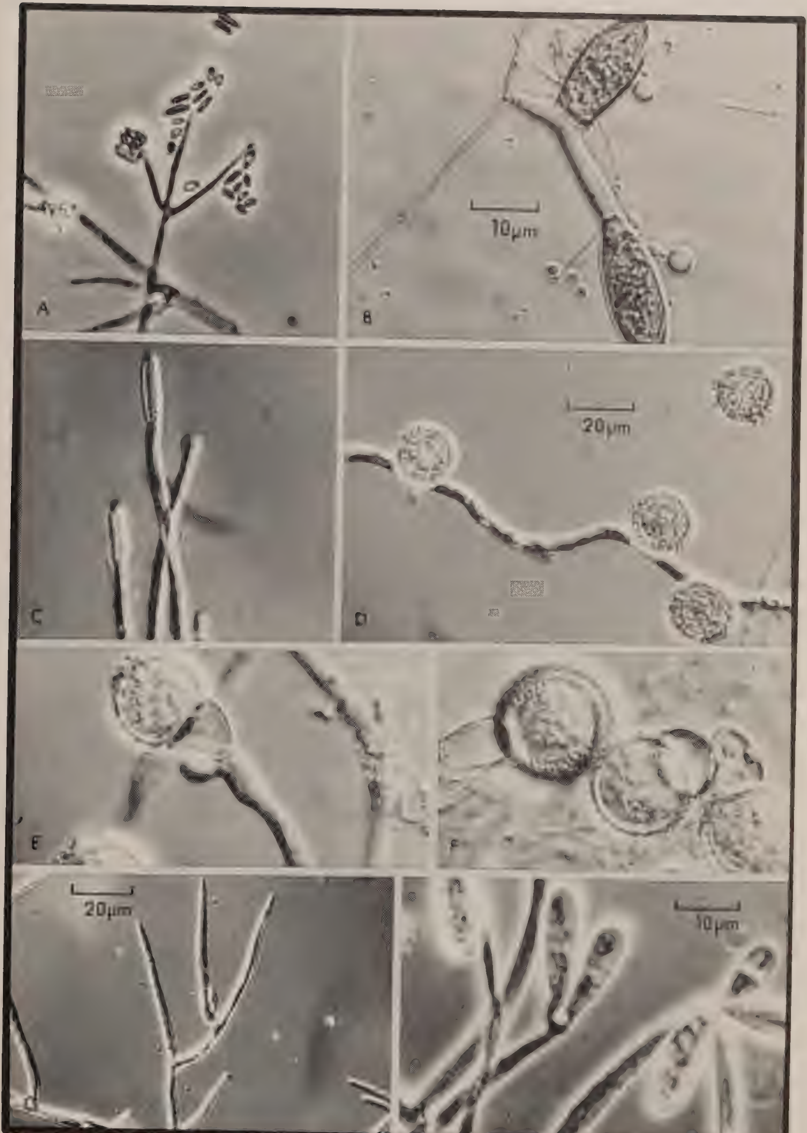
Superficially *A. clavispora* resembles species of *Cladobotryum*, but the development of its conidiogenous cells is different from that of *C. varium* and *C. mycophilum*. Production of an acropetal succession of conidia by sympodial proliferation distinguishes *A. clavispora* from fungi of similar morphology. In this respect it resembles *C. dendroides* (Bull. ex Merat) Gams & Hoozem. [anamorph of *Hypomyces rosellus* (Alb. & Schw. ex Fr.) Tul.] which Barron (1968) and Cole and Kendrick (1971) consider to be unsatisfactorily classified in *Cladobotryum*. *C. dendroides* would, perhaps, be better classified in *Arnoldia*. *A. clavispora* also bears some similatiry to *Trichothecium roseum* Link, but again differs significantly in the peculiarities of conidiogenesis. Kendrick and Cole (1969) have shown *T. roseum* to produce meristem arthrospores of a unique kind.

Cladobotryum apiculatum (Tubaki) Gams & Hoozemans, Persoonia 6: 97, 1970 (Fig. 2).

≡ *Cylindrophora apiculata* Tubaki, Nagaoa 5: 6, 1955.

Colonies effuse, white to cream, thick, covering much of the host pileus. Mycelium mostly superficial, composed of branched, septate, hyaline, smooth, 4-7µm wide hyphae. Chlamydospores formed terminally or laterally on very short branches, solitary, dry, minutely verruculose, relatvely thick-walled, subhyaline to very pale brown, composed of from two to four cells, distinctly constricted at the septa separating individual cells, 34-65µm long, up to 32µm wide at the broadest part. Conidiophores semimacronematous, mononematous, branched, straight or somewhat flexuous, hyaline, smooth, septate, cylindrical, up to 170µm long. Conidiogenous cells discrete, borne terminally and laterally on the conidiophores, more or less cylindrical but attenuating towards the apex, up to

PLATE 1. A. *Hypomyces tulasneanus*, conidiophores and conidia; B. *H. tulasneanus*, chlamydospores; C. *Sepedonium mycophilum*, conidiophores and conidia; D. *S. mycophilum*, chlamydospores; E. *Mycogone perniciosa*, chlamydospores; F. *Mycogone rosea*, chlamydospores; G-H. ***Arnoldia** clavispora*, conidiophores and conidia.


A
B
10µm
C
D
20µm
E
F
20µm
10µm

67µm long, 3-4.5µ wide, 1-1.5µm wide at the extreme apex. Conidia holoblastic, produced as a terminal blow-out of individual conidiogenous cells, cylindrical to narrowly obovoid, smooth, non-septate, hyaline, with a narrow truncate base, 17-28 X 5-6.5µm.

On carpophores of *Amanita, Lactarius* and *Russula*; Europe, Japan and North America.

Collection examined: on *Lactarius* sp., off Rt. 50, 5ml. south of Lafayette, Chambers County, Alabama, July 26, 1979, D.J. Gray and G. Morgan-Jones, AUA.

The name *Blastotrichum puccinioides* Preuss [*Mycogone puccinioides* (Preuss) Saccardo] is based on the chlamydospore state of this fungus.

To our knowledge the Alabama collection represents the first record of its occurrence in North America.

Cladobotryum mycophilum (Oudem.) Gams & Hoozemans, Persoonia 6: 102, 1970 (Fig. 3, Plate 2 A-B).

≡ *Dactylium mycophilum* Oudemans, Arch. Neerl. Sci. 2: 42, 1867.

= *Diplocladium elegans* Bain. & Sart., Ann. Mycol. 11: 359, 1913.

[Anamorph of *Hypomyces odoratus* Arnold, Česká Mykol. 11: 144, 1964]

Colonies effuse, hyaline to pale rose, thin, floccose. Mycelium superficial on hymenial surface of carpophores, composed of cylindrical, flexuous, branched, septate, hyaline, smooth-walled, 5-10µm wide hyphae. Conidiophores semimacronematous, mononematous, branched, straight or slightly flexuous, hyaline, smooth, cylindrical, bearing a terminal verticil of up to five conidiogenous cells; conidiogenous cells also formed on short lateral branches and intercalarily from the main stipe immediately below septa towards the distal end. Conidiogenous cells discrete, arranged verticillately, narrowly lageniform to more or less cylindrical but narrower at the blunt apex, 25-60 X 5-6µm. Conidia holoblastic, produced as a terminal blow-out at the tip of individual conidiogenous cells, usually developing asymmetrically, clavate to ellipsoid, hyaline, smooth, 1 to 3-septate, narrowly truncate at the base, 20-31 X 5-9µm.

On carpophores of members of the Agaricales and Aphyllophorales; Europe, Japan and North America.

Collection examined: on *Coriolus versicolor*, Chewacla State Park, Lee County, Alabama, March 23, 1978, D.J. Gray, AUA.

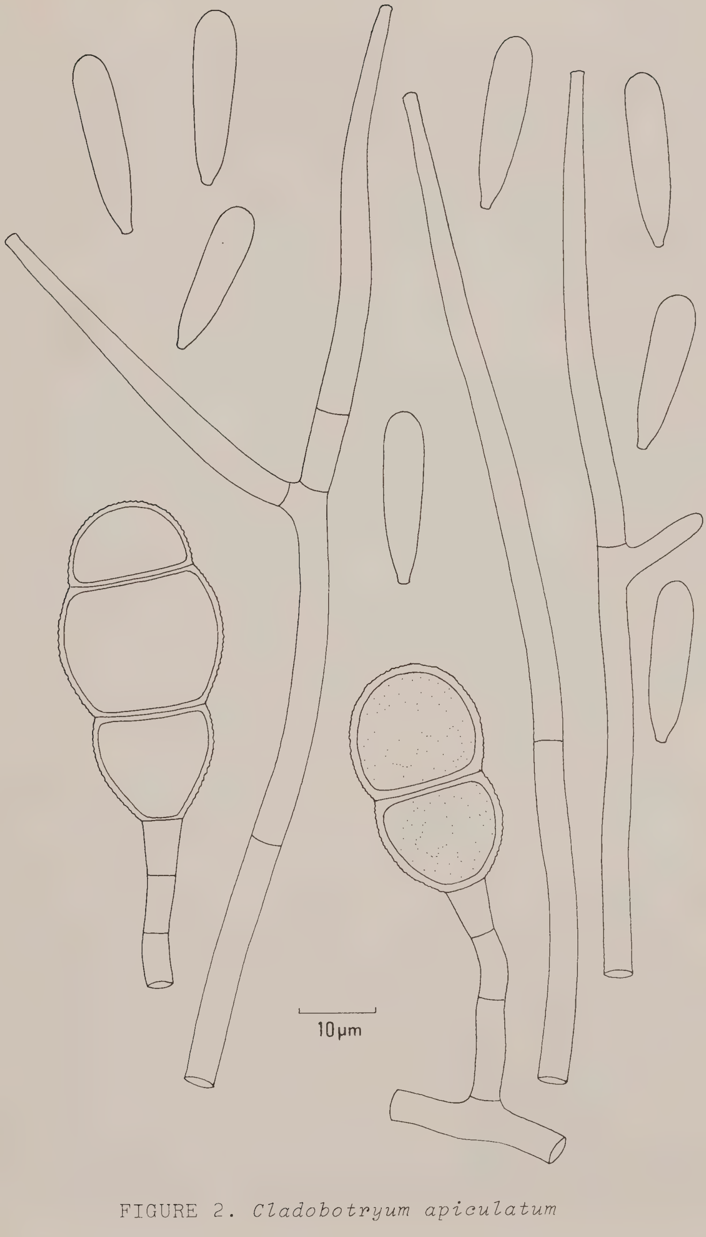


FIGURE 2. *Cladobotryum apiculatum*

Cladobotryum varium Nees, Syst. Pilze Schwamme 56, 1816 (Fig. 4, Plate 2 C-D).

≡ *Dactylium varium* (Nees) Fr., Syst. Mycol. 3: 414, 1832.

= *Botrytis variospermum* Link, Mag. Ges. Naturf. Freunde, Berlin 7: 36, 1816.

= *Cladobotryum variospermum* (Link) Hughes, Can. J. Bot. 36: 750, 1958.

[Anamorph of *Hypomyces aurantius* (Pers. ex S.F. Gray) Tul., Sel. Fung. Carpol. 3: 43, 1865]

For full nomenclator see Gams and Hoozemans (1970).

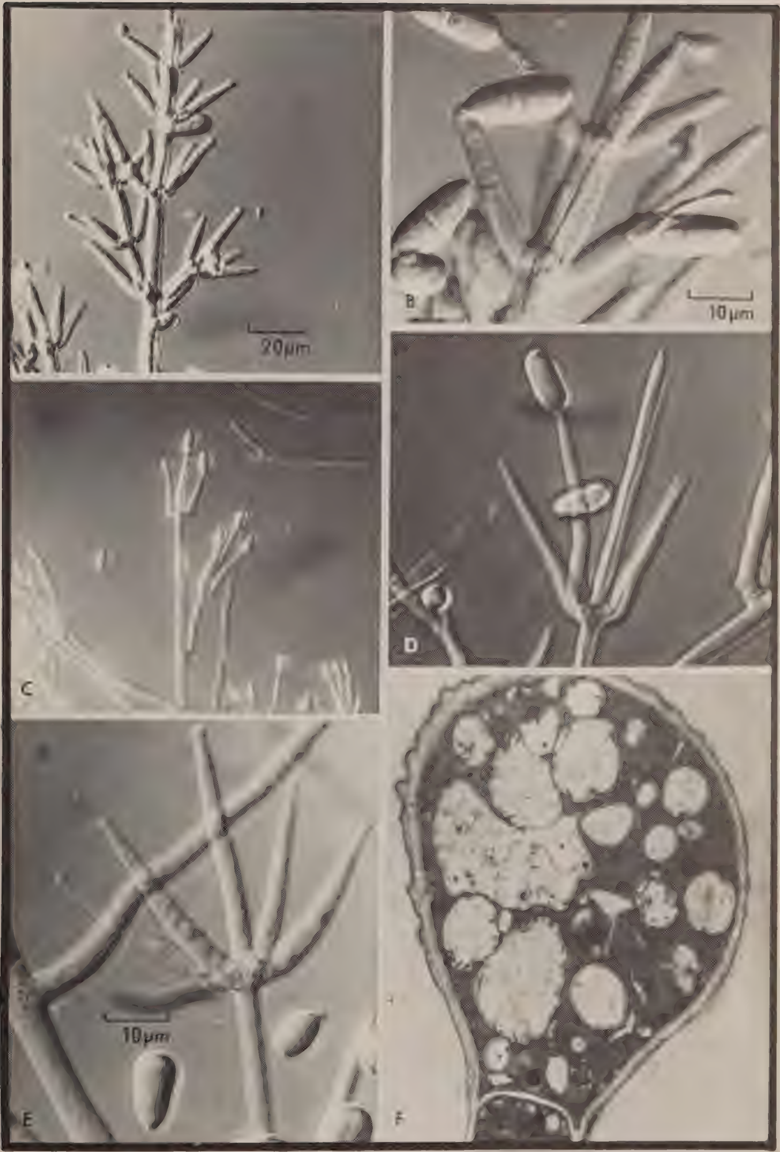
Colonies effuse, white, becoming yellowish tan with age, thin, matted. Colonies on PDA spreading rapidly (up to 22mm per 24h at 25°C), radiate zones of thicker growth soom apparent, reverse pale yellow. Mycelium mostly superficial on carpophores, white, composed of cylindrical, flexuous, branched, septate, hyaline, smooth-walled, 5-10µm wide hyphae. Conidiophores semimacronematous, mononematous, branched, straight or flexuous, hyaline, smooth, cylindrical, bearing a terminal verticil of up to five compactly arranged conidiogenous cells, with one or two conidiogenous cells borne on non-divergent lateral branches originating immediately below septa towards the distal end. Conidiogenous cells discrete, arranged verticillately, single or in pairs, more or less cylindrical, blunt at the apex, 24-50 X 3-5µm. Conidia holoblastic, ellipsoid to ovoid, hyaline, smooth, 1-septate, 10-16 X 6-7µm, truncate at the base.

On basidiomycete carpophores, in soil and on rotten wood; Europe and North America.

Collection examined: isolated from soil, North Bay, Ontario, Canada, 1965, G.L. Barron, ATCC 16080.

Cole and Kendrick (1971) demonstrated that the conidiogenous cells of *C. varium* produce a series of conidia in basipetal succession and become progressively shorter in the process. Kendrick (1971) referred to these conidia as meristem arthrospores. Hashmi (1977) showed that the conidia of *C. mycophilum* are produced holoblastically from a determinate, retrogressive conidiogenous cell. Although *C. verticillatum* also bears holoblastic conidia there is no known commensurate reduction in conidiogenous cell length in that species.

PLATE 2. A-B. *Cladobotryum mycophilum*, conidiophores and conidia; C-D. *C. varium*, conidiophores and conidia; E. *C. verticillatum*, conidiophores and conidia; F. *C. verticillatum*, thin section of conidiophore tip and developing conidium (transmission electron micrograph).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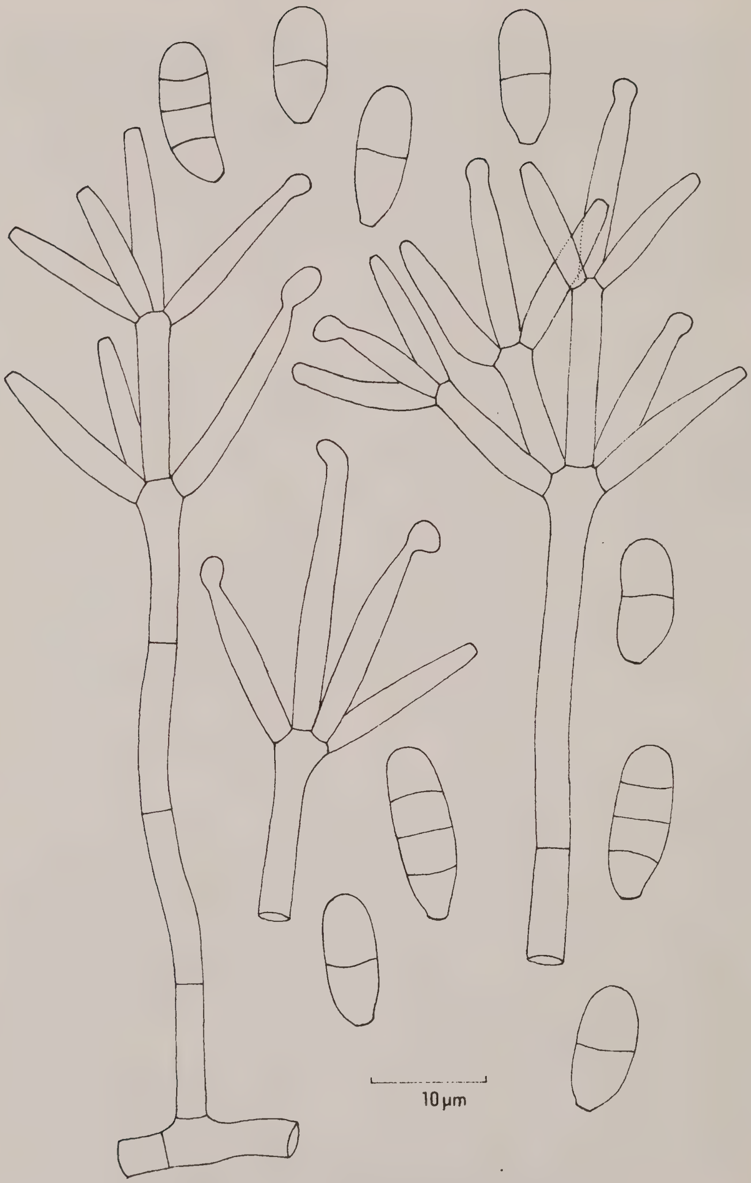


FIGURE 3. *Cladobotryum mycophilum*

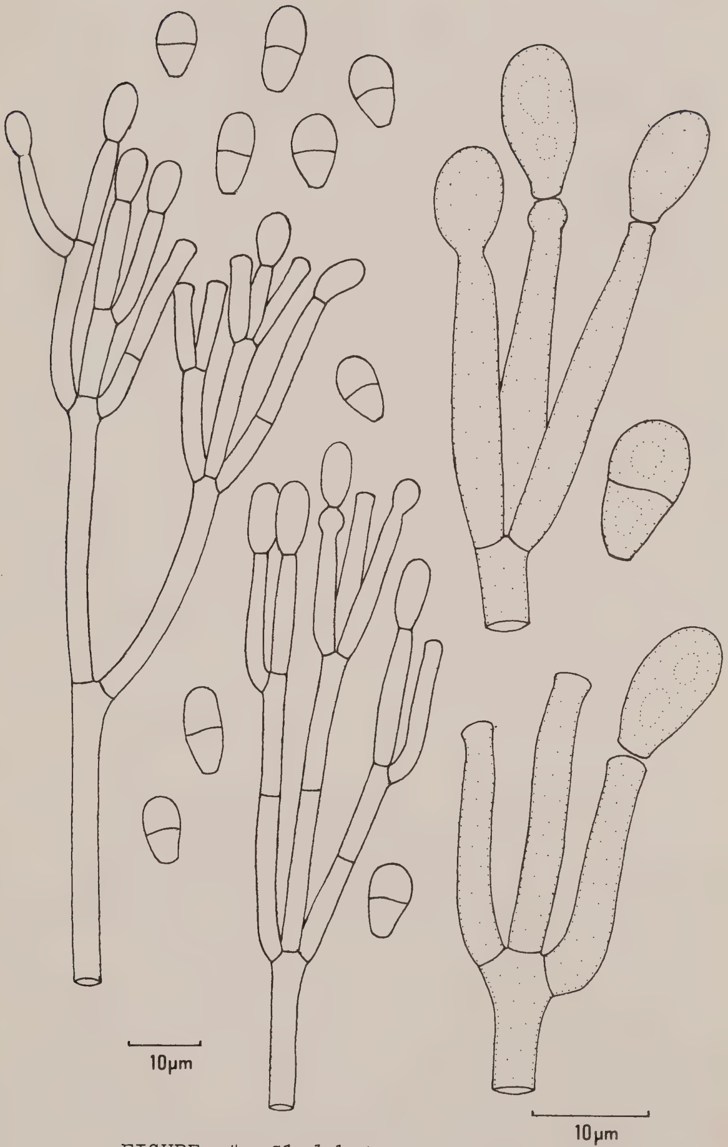


FIGURE. 4. *Cladobotryum varium*

Cladobotryum verticillatum (Link) Hughes, Can. J. Bot. 36: 750, 1958 (Fig. 5, Plate 2 E-F).

≡ *Acremonium verticillatum* Link, Mag. Ges. Naturf. Freunde, Berlin 3: 15, 1809.

≡ *Mycogone verticillata* (Link) Spreng., Linn. Syst. Veg. XVI, 4: 555, 1827.

For full nomenclator see Gams and Hoozemans (1970).

Colonies effuse, white, thick, floccose, often totally covering host carpophores. Colonies on PDA spreading rapidly (up to 31mm per 24h at 25°C), white, thick, cottony, reverse yellowish gray. Mycelium partly immersed in the carpophore, partly superficial, composed of branched, cylindrical, flexuous, hyaline, smooth, 4-11μm wide hyphae. Chlamydospores produced abundantly in culture on PDA, mostly terminal, as chains of swollen, thicker-walled, constricted, pale yellowish-brown, 15-30 X 10-25μm cells. Conidiophores semimacronematous, mononematous, branched, straight or slightly flexuous, hyaline, cylindrical, smooth, bearing a terminal verticil of up to four conidiogenous cells; conidiogenous cells also formed terminally on short, lateral branches and intercalarily, singly or in groups os two or three, from the main stipe immediately below septa towards the distal end. Conidiogenous cells discrete, arranged verticillately, more or less cylindrical but narrower towards the apex, 30-75 X 2-4μm. Conidia holoblastic, produced as a terminal blow-out at the tips of individual conidiogenous cells, ellipsoid to pyriform, hyaline, smooth, non-septate, somewhat papillate at the extreme base, 8-20 X 5-11μm.

On carpophores of *Boletus, Lactarius* and *Russula*; Europe and North America.

Collections examined: on *Russula* sp., Auburn, Lee County, Alabama, November 6, 1977, G. Morgan-Jones, AUA; on *Lactarius* sp., Chewacla State Park, Lee County, Alabama, November 8, 1977, D.J. Gray, AUA; on *Russula emetica* (Fr.) Pers., Tuskegee National Forest, Macon County, Alabama, November 11, 1977, D.J. Gray, AUA; on *Russula* sp., Auburn, Lee County, Alabama, August 11, 1978, D.J. Gray, AUA; on *Boletus* sp., Auburn, Lee County, Alabama, August 12, 1978, D.J. Gray, AUA.

Although the conidiogenous cells of *C. verticillatum* have a morphology normally associated with a phialide, it is evident from transmission electron micrographs of thin longitudinal sections of their tips that at least the first conidium formed is holoblastic in origin (Plate 2 F). An uninterupted continuity is evident between the wall of the conidiogenous cell and that of the developing conidium.

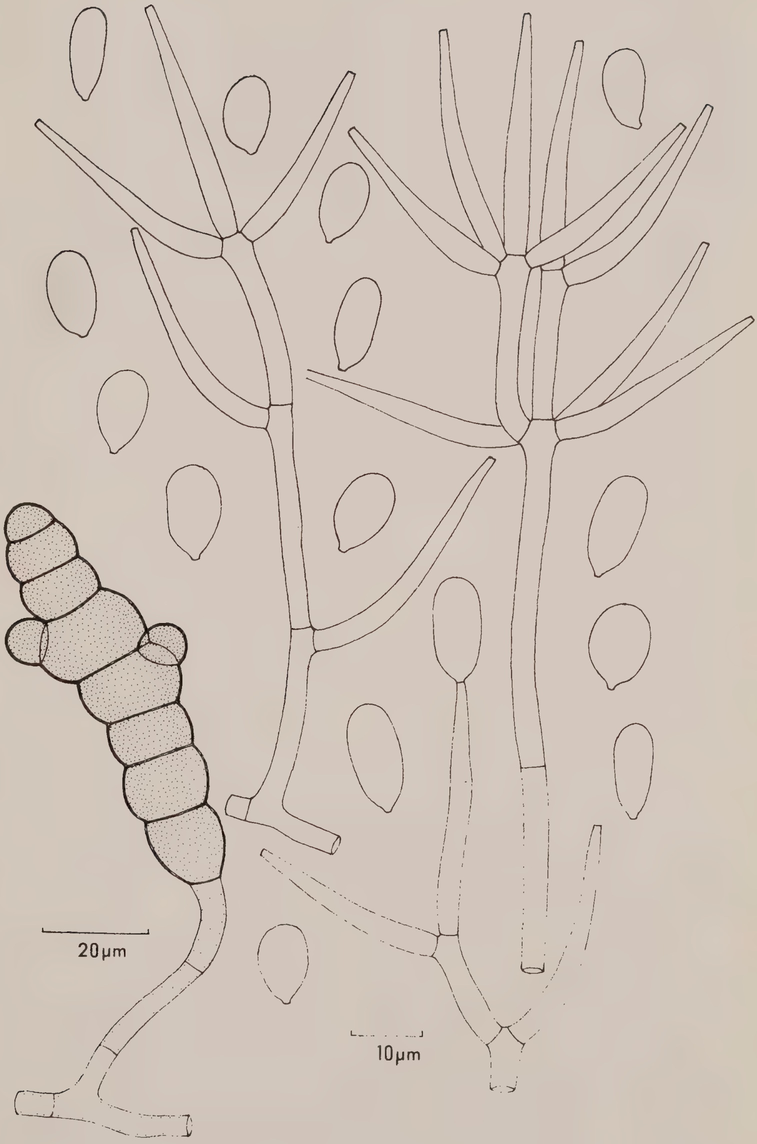


FIGURE 5. *Cladobotryum verticillatum.*

Hypomyces tulasneanus Plowright, Grevillea 9: 46, 1882 [anamorph of], (Fig. 6, Plate 1 A-B).

Colonies compact, white to pale yellow, thin. Colonies on PDA white, pulveraceous, becoming pale yellow to ochre from the center outwards as chlamydospores are formed, reverse dull yellow, extending at a rate of 17mm per 24h at 25°C. Mycelium on carpophores mainly superficial, partly immersed, composed of cylindrical, flexuous, branched, septate, hyaline, smooth-walled, 2-4μm wide hyphae. Chlamydospores formed terminally on short, lateral hyphal branches, solitary, dry, smooth, thick-walled, pale yellow to yellow, ellipsoid to naviculate, broadly truncate at the base, obtuse to somewhat pointed at the apex, 20-35 X 7-15μm. Conidiophores micronematous to semimacronematous, *Verticillium*-like, straight or slightly flexuous, hyaline, smooth, septate, with a terminal verticil of up to five conidiogenous cells, or with conidiogenous cells formed laterally on undifferentiated hyphae. Conidiogenous cells monophialidic, discrete, determinate, more or less cylindrical, attenuating very gradually towards the apex, 17-36 X 1-2μm. Conidia enteroblastic, produced in basipetal succession at the phialide tips, variable in size, oblong to narrowly oval, hyaline, smooth, non-septate, 4-14 X 2-4μm.

On carpophores of *Boletus*; Europe, Japan and North America.

Collections examined: on *Boletus* sp., Chewacla State Park, Lee County, Alabama, September 20, 1977, D.J. Gray, AUA; on *Boletus* sp., 2ml. west of Auburn off Hwy 14, Lee County, Alabama, September 21, 1977, D.J. Gray, AUA; on *Boletus* sp., Auburn, Lee County, Alabama, September 23, 1977, G. Morgan-Jones, AUA; on *Boletus* sp., Auburn, Lee County, Alabama, August 11, 1978, D.J. Gray, AUA.

There is no established binomial available for the anamorph of *H. tulasneanus*. As indicated above the phialidic state is characteristic of *Verticillium*. The distinct and unique morphology of the chlamydospores distinguishes it from that genus however.

Mycogone perniciosa Magnus, Bot. Centralbl. 394, 1888 (Fig.7, Plate 1 E).

Colonies restricted, compact, white to greyish, thin, somewhat lanose, pulveraceous. Colonies on PDA spreading relatively slowly (up to 9mm per 24h at 25°C), reverse brownish. Mycelium mostly superficial on carpophores, composed of cylindrical, flexuous, branched, septate, hyaline, smooth-walled, 2-5μm wide hyphae. Chlamydospores formed terminally and laterally on short lateral hyphal branches, solitary, dry, 1-septate, with a large, spherical, thick-walled, subhyaline to yellowish, verrucose, 20-24μm wide upper cell and a smaller, subhyaline, 10-15μm wide

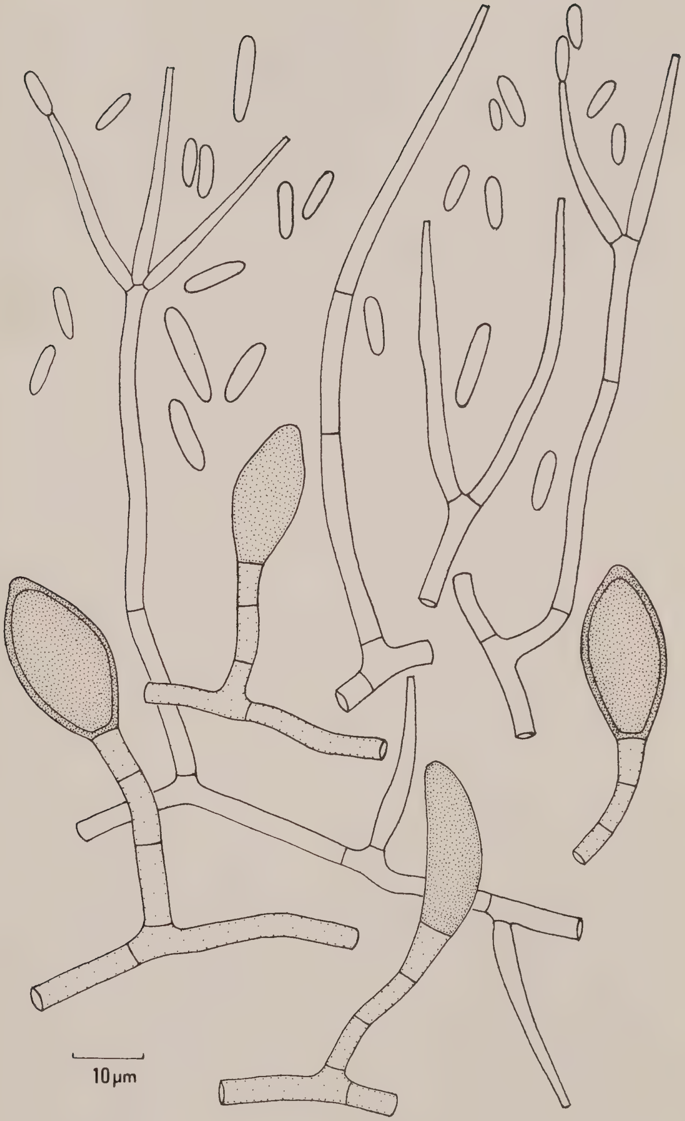


FIGURE 6. *Hypomyces tulasneanus.*

basal cell; the surface excresences on the upper cell varying from discrete and rounded to short ridges that sometimes coaslesce. Conidiophores micronematous to semimacronematous, mononematous, *Verticillium*-like, straight or slightly flexuous, hyaline, smooth, septate, bearing one or two conidiogenous cells terminally and one or two laterally immediately below transverse septa, or with conidiogenous cells formed laterally on undifferentiated hyphae. Conidiogenous cells monophialidic, discrete, determinate, more or less cylindrical, attenuating gradually towards the apex, 20-60 X 2.5-3µm. Conidia enteroblastic, produced in basipetal succession at the phialide tips, oblong, hyaline, smooth, non-septate, 12-22 X 3-4µm.

On carpophores of *Agaricus* spp.; Europe and North America.

Collection examined: isolated from cultivated mushroom, U.S.A., W.T. Jeffers, ATCC 10934.

Mycogone rosea Link ex Link, Mag. Ges. Naturf. Freunde, Berlin 3: 18, 1809 (Fig. 8, Plate 1 F).

≡ *Sepedonium roseum* (Link) Fr., Syst. Mycol. 3: 438, 1832.

≡ *Mycobanche rosea* (Link) Wallroth, Flora Crypt. German., 2: 273, 1833.

Colonies effuse, white, becoming brownish in patches, thin, floccose at matted with age. Colonies on PDA spreading at a rate of up to 12mm per 24h at 25°C. Mycelium mostly superficial on carpophores, composed of branched, cylindrical, flexuous, hyaline, smooth, 1.5-3µm wide hyphae. Chlamydospores formed on short lateral hyphal branches, solitary, with a large spherical, thick-walled, yellowish brown, verrucose, 20-28µm wide upper cell and a smaller, smooth-walled, subhyaline, 12-15µm wide basal cell; the surface excresnces on the upper cell are small, crowded, and sometimes coalescing. Conidiophores micronematous to semimacronematous, mononematous, *Verticillium*-like, straight or slightly flexuous, hyaline, smooth, septate, bearing one to three conidiogenous cells terminally, and one or two laterally, immediately below transverse septa, or with conidiogenous cells formed laterally on undifferentiated hyphae. Conidiogenous cells monophialidic, discrete, determinate, more or less cylindrical, attenuating gradually towards the apex, 20-40 X 3-4µm. Conidia enteroblastic, produced in basipetal succession at the phialide tips, somewhat variable in size, oblong to cylindrical, obtuse at the ends, hyaline, smooth, non-septate or, more rarely 1 to 2-septate, 10-15 X 3-4µm.

On carpophores of members of the Agaricales; Europe.

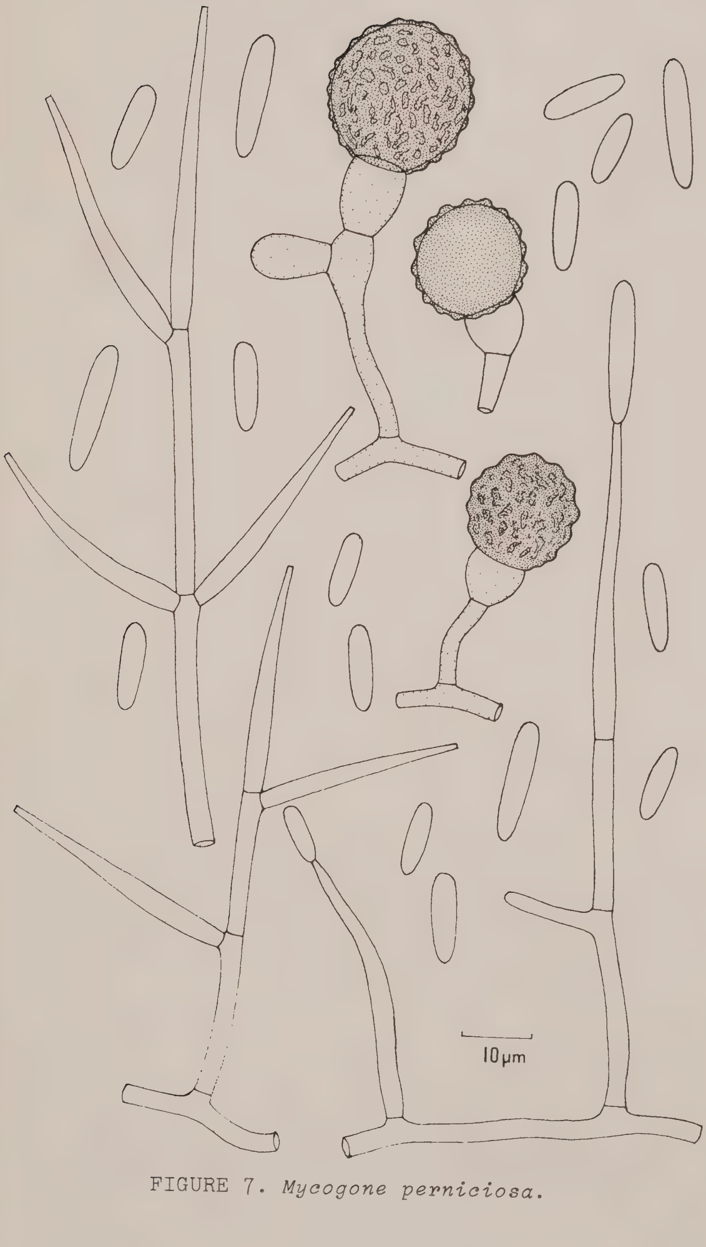


FIGURE 7. *Mycogone perniciosa.*

Collection examined: isolated from *Amanita fulva* (Schaeff.) Pers., near Augustów, Poland, 1966, W. Gams, CBS 488.67.

Sepedonium mycophilum (Pers.) Nees, Das System 44, 1816/1817 (Fig. 9, Plate 1 C-D).

≡ *Uredo mycophila* Persoon, Syn. Meth. Fung.: 214, 1801.

= *Mycobanche chrysosperma* Persoon, Traite sur Champign.: 133, 1818.

= *Sepedonium chrysosperma* (Pers.) Fr., Syst. Mycol. 3: 438, 1832.

For full nomenclator see Hughes (1958).

Colonies effuse, thick, floccose, white, becoming bright golden yellow upon production of chlamydospores. Colonies on PDA thin, spreading moderately (up to 14mm per 24h at 25°C). Mycelium partly superficial, partly immersed in the carpophore, composed of branched, cylindrical, flexuous, hyaline to pale straw yellow, smooth or somewhat verruculose, 2-5µm wide hyphae. Chlamydospores formed either terminally on vegetative hyphae or laterally on short branches, solitary, dry, acrogenous, spherical, thick-walled, distinctly tuberculate, golden yellow, 13-18µm in diameter. Conidiophores semimacronematous, mononematous, straight or flexuous, smooth, hyaline to pale yellow, bearing a terminal group of usually three conidiogenous cells and individual conidiogenous cells terminating short, lateral, septate branches. Conidiogenous cells monophialidic, cylindrical, attenuating slightly towards the apex, 20-75 X 3-4µm. Conidia enteroblastic, produced at the tips of the phialides, oblong, very pale yellow, smooth, fairly thick-walled, 17-22 X 2-6µm.

On carpophores of Basidiomycetes; cosmopolitan.

Collections examined: on *Boletus* sp., Auburn, Lee County, Alabama, August 11, 1977, G. Morgan-Jones, AUA; on *Boletus* sp., Chewacla State Park, Lee County, Alabama, September 21, 1977, D.J. Gray, AUA; on *Boletus* sp., Fourmile Village, Walton County, Florida, September 23, 1979, C.A. Carr, AUA.

Sibirina fungicola Arnold, Nova Hedwigia 19: 300, 1970 (Fig. 10, Plate 3 G-H).

[Anamorph of *Hypomyces semitranslucens* Arnold]

Colonies on PDA white to pale ochraceous with age, thin, floccose, becoming somewhat pulveraceous with conidium production, reverse yellowish brown. Mycelium

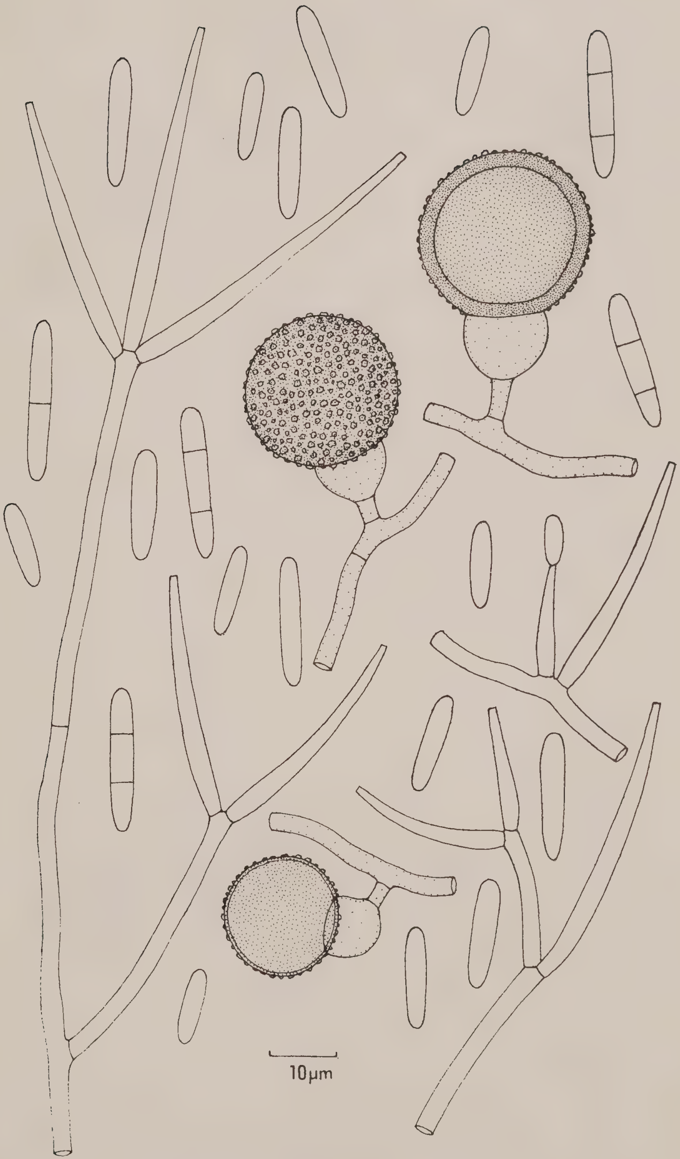


FIGURE 8. *Mycogone rosea*

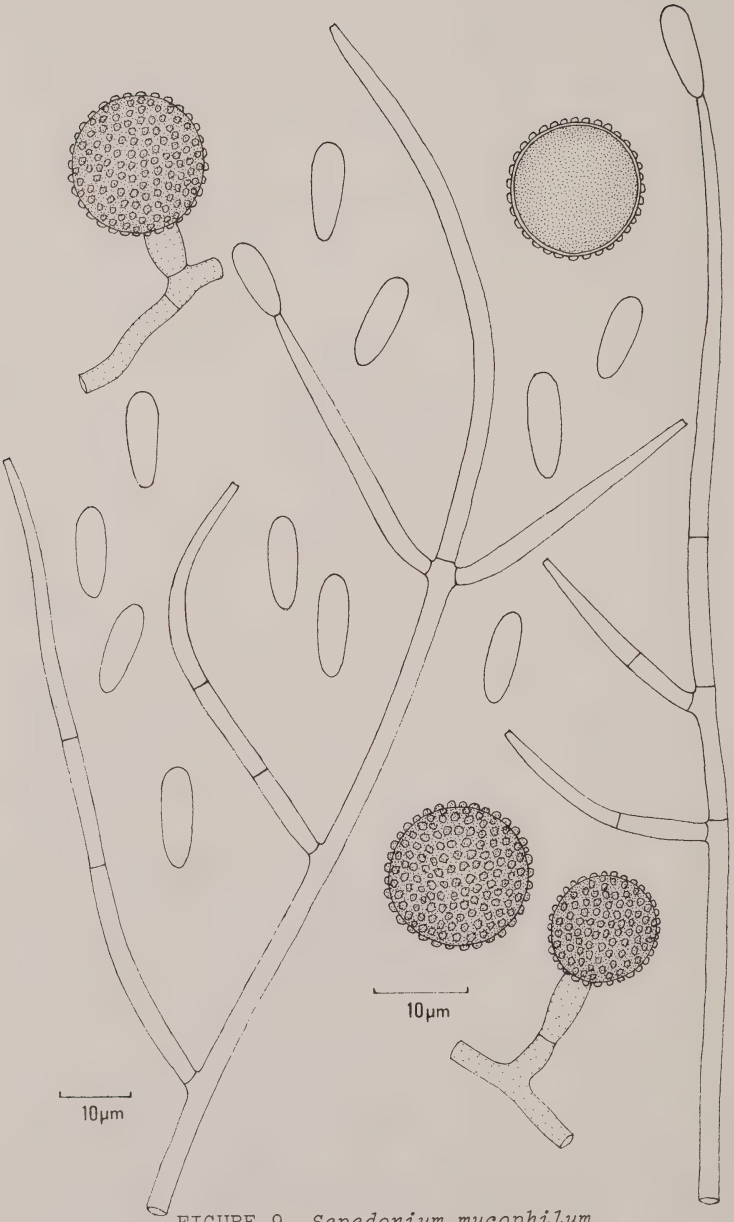


FIGURE 9. *Sepedonium mycophilum*

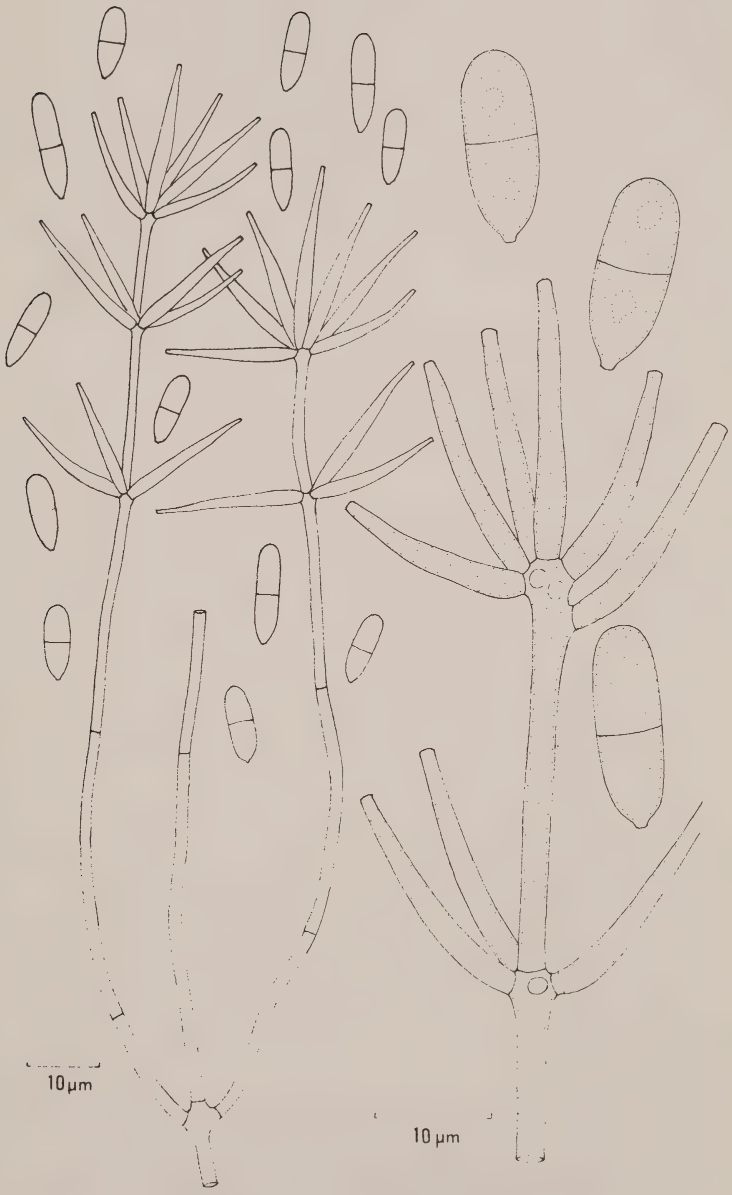


FIGURE 10. *Sibirina fungicola*

composed of cylindrical, flexuous, branched, hyaline, septate, smooth-walled, 3-6µm wide hyphae. Conidiophores semimacronematous, mononematous, straight or flexuous, hyaline, smooth, septate, branched, bearing a terminal dense verticil of up to sixteen conidiogenous cells; conidiogenous cells also often produced in a subterminal position and in groups laterally, immediately below transverse septa towards the distal end or, less frequently, terminally on short lateral branches. Conidiogenous cells monophialidic, discrete, arranged verticillately, determinate, more or less cylindrical, attenuating gradually towards the tip, 15-34 X 2-3µm. Conidia produced at the tips of the phialides, ovoid, hyaline, 1-septate, frequently biguttulate, 12-20 X 3-5.5µm, papillate at the base.

On carpophores of *Lentinus* sp., and *Polyporus varius* Pers. ex Fr.; Asia and Europe.

Collections examined: isolated from *Lentinus* sp., Rassocha, Lakutsk region, U.S.S.R., August 3, 1968, G.R.W. Arnold, JE, LE, CBS 458.71, isotype; received as *Hypomyces semitranslucens* from G.R.W. Arnold (Arnold M309).

The genus *Sibirina* Arnold, based on *S. fungicola*, was noted by Arnold (1970) to be closely related to *Verticillium* Nees ex Link but differing from it in having two-celled conidia. The conidia are also appreciably larger than in any species of *Verticillium*. Gams (1973) subsequently recognized *S. fungicola* to be somewhat unique in that its conidia are strictly solitary; that is, a new conidiogenous cell is formed for each conidium produced. This results in the production of a dense verticil. A second species, *Sibirina orthospora* Gams, shows close similarity to *S. fungicola* but bears conidiogenous cells that produce more than one conidium.

Sibirina gamsii sp. nov. (Fig. 11, Plate 3 A-B).

Coloniae compactae, sparsae, albidae. Mycelium partim superficiale, partim in substrato immersum, ex hyphis ramosis, septatis, hyalinis, laevibus, 3-7µm crassis compositum. Conidiophora micronemata vel semimacronemata, mononemata, erecta, recta vel flexuosa, simplicia, septata, hyalina, laevia. Cellulae conidiogenae monophialidicae, determinatae, cylindricae, hyalinae, 3 - 5 in verticillo disposae, 11-30 X 2-3µm, collario nullo. Conidia obovata, uniseptata, levites constricta ad septa, hyalina, levia, 13-18 X 6-8µm.

Ad carposomata Polypori, Chewacla State Park, Lee County, Alabama, March 23, 1978, D.J. Gray, AUA, holotypus.

Colonies compact, thin, white, becoming somewhat pulveraceous with conidium production, reverse yellowish

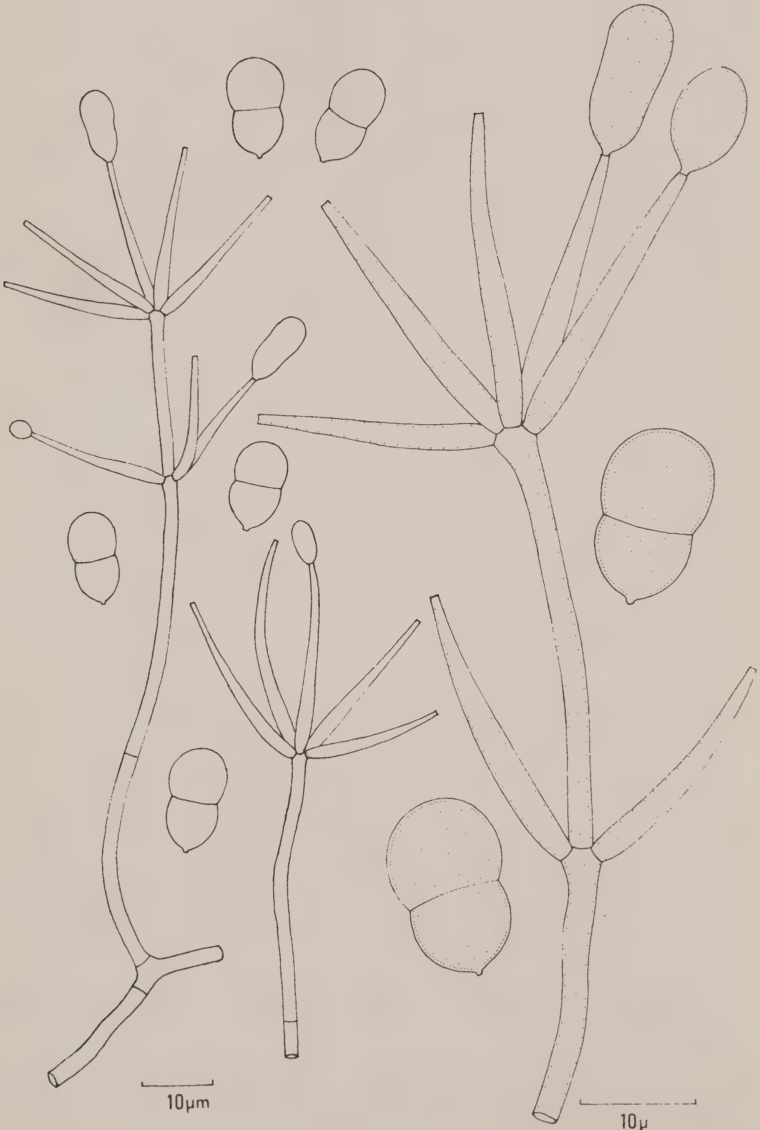


FIGURE 11. *Sibirina gamsii*

brown. Colonies on PDA spreading at a rate of 8mm per 24h at 25°C. Mycelium partly superficial, partly immersed in the substrate, composed of cylindrical, flexuous, branched, septate, hyaline, smooth-walled, 3-6μm wide hyphae. Conidiophores micronematous or semimacronematous, mononematous, erect, straight or slightly flexuous, *Verticillium*-like, hyaline, smooth, with a terminal verticil of three to five conidiogenous cells; conidiogenous cells also produced in groups of two to three laterally, immediately below transverse septa towards the distal end. Conidiogenous cells monophialidic, discrete, arranged verticillately, determinate, more or less cylindrical, attenuating gradually towards the tip, 11-30 X 2-3μm. Conidia enteroblastic, produced in basipetal succession at the tips of the phialides, obovate, one-septate, constricted at the septum, upper cell regularly larger than the lower, hyaline, smooth, 13-18 X 6-8μm, bearing a small papilla at the extreme base.

On carpophores of *Polyporus* sp.; North America.

Collection examined: on *Polyporus* sp., Chewacla State Park, Lee County, Alabama, March 23, 1978, D.J. Gray, AUA, type.

S. gamsii is readily distinguishable from *S. fungicola* and *S. orthospora* by its slender conidiophores and the morphology of its conidia.

Sibirina purpurea Morgan-Jones sp. nov. (Fig. 12, Plate 3 C-E).

Coloniae celeriter crescunt, effusae, floccosae vel velutinae, densae vel sparsae, roseae vel purpureae. Mycelium effusum, album vel pallide roseum, partim superficiale, partim in substrato immersum, ex hyphis ramosis, septatis, hyalinis, levibus, 3-7μm crassis compositum. Sclerotia minuta, alba vel brunnea adsunt. Conidiophora semimacronemata, mononemata, erecta, recta vel flexuosa, simplicia vel parce irregulariter ramsoa, septata, hyalina, laevia. Cellulae conidiogenae monophialidicae, determinatae, cylindricae, hyalinae, 2 - 8 in verticillo disposae, 30-50 X 4-5μm, collario nullo. Conidia obovata, uniseptata, levia, hyalina, 11-17 X 6-14μm.

Ad carposomata Sterei, Chewacla State Park, Lee County, Alabama, August 10, 1977, G. Morgan-Jones, AUA, holotypus.

Colonies effuse, floccose to velvety, dense or sparse, rose to cherry red to purple in colour, frequently staining host tissue similarly. Colonies on PDA spreading rapidly (up to 20mm per 24h at 25°C), at first rather sparse, white to cream to pale straw yellow, becoming reddish and velvety to floccose, medium eventually staining deep cherry red. Mycelium at first white, later

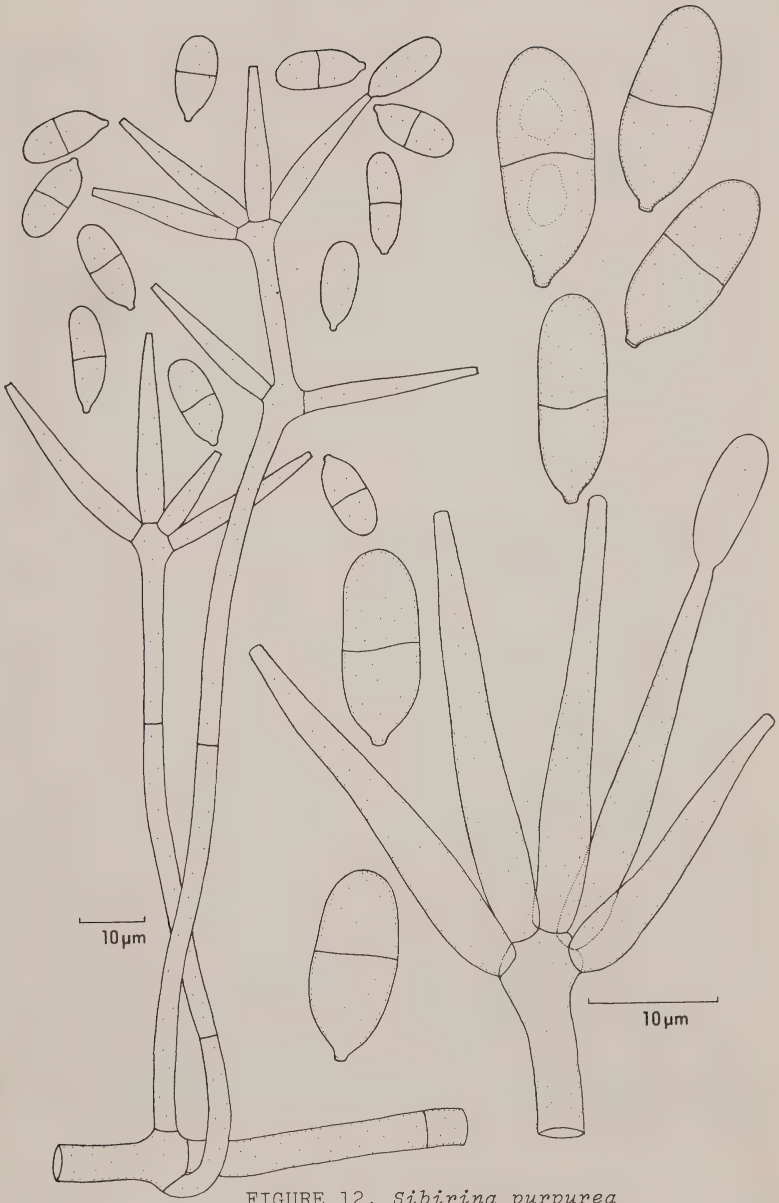


FIGURE 12. *Sibirina purpurea*

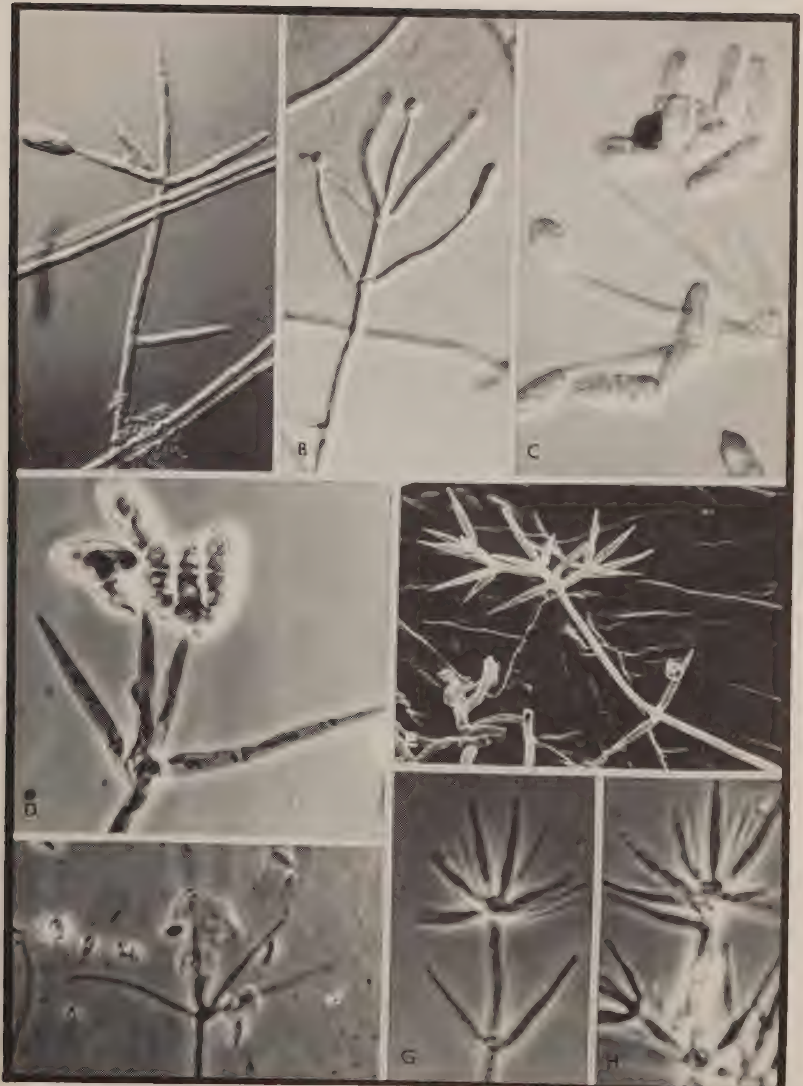
appearing rosy-pink. Reverse dark brown. Colonies on 2% malt agar thick, floccose, becoming yellowish. Mycelium on host partly superficial, partly immersed in the substratum, composed of branched, cylindrical, flexuous, hyaline, smooth, 2.5-7µm wide hyphae. Pigment appearing as yellow crystals encrusting mature hyphae. Sclerotia produced abundantly in culture, at first white, later becoming reddish-brown, up to 1mm in diameter at maturity, pseudoparanchymatous in texture. Conidiophores semi-macronematous, mononematous, erect, straight or slightly flexuous, septate, simple or irregularly branched, cylindrical, hyaline, smooth, with a terminal verticil of up to five conidiogenous cells; conidiogenous cells also produced in groups laterally directly from the main stipe or terminally on short lateral branches. Conidiogenous cells monophialidic, determinate, more or less cylindrical, attenuating towards the tip, 30-50 X 4-5µm. Conidia enteroblastic, produced in basipetal succession at the tips of the conidiogenous cells, ovoid, hyaline, smooth, 1-septate, slightly papillate at the base, basal cell usually a little larger, guttulate, 11-17 X 6-14µm.

On carpophores of *Lenzites betulina* L. ex Fr., *Marasmius* spp. and *Stereum* sp.; North America.

Collections examined: on *Stereum* sp., Chewacla State Park, Lee County, Alabama, August 10, 1977, G. Morgan-Jones, AUA, CBS 154.78, JE, type; on *L. betulina*, Tallassee, Elmore County, Alabama, September 20, 1977, D.J. Gray, AUA; on *Marasmius* spp., Rt. 50, 5ml. south of Lafayette, Chambers County, Alabama, July 26, 1979, G. Morgan-Jones and D.J. Gray, AUA; on *L. betulina*, F.D. Roosevelt State Park, Harris County, Georgia, August 16, 1979, G. Morgan-Jones, AUA.

Sibirina purpurea differs from *S. fungicola* in a number of respects. More than one conidium is produced from each conidiogenous cell and there are fewer of them per conidiophore. The conidia and details of conidiophore morphology are also different. Cultural characteristics, particularly pigmentation, are also at variance. *Sibirina purpurea* seems closely related to the anamorphs of the *Hypomyces rosellus* complex but it is not the conidial state of *H. dactylarioides* Arnold, *H. odoratus* Arnold, *H. paconius* Berk. and Br., or *H. rosellus* (Alb. & Schw. ex Fr.) Tul. An odor is produced by cultures of *S. purpurea* similar to that known in *Hypomyces ochraceus* (Pers. ex Fr.) Tul.

PLATE 3. A-B. *Sibirina gamsii*; conidiophores and conidia; C-D. *S. purpurea*, conidiophores and conidia; E. *S. purpurea*, conidiophores (scanning electron micrograph); F. *Verticillium fungicola*, conidiophore and conidia; G-H. *S. fungicola*, conidiophores.


B
C
D
G
H

Verticillium fungicola (Preuss) Hassebrauk, Phytopath. Z. 9: 514, 1936 (Fig. 13, Plate 3 F).

≡ *Acrostalagmus fungicola* Preuss, Linnaea 24: 124, 1851.

Colonies compact, white to cream, thin, pulveraceous. Colonies on PDA spreading rapidly (up to 10mm per 24h at 25°C), white, floccose, reverse pale yellowish. Mycelium mostly superficial on carpophore, composed of cylindrical, flexuous, branched, septate, hyaline, smooth, 1-3µm wide hyphae. Conidiophores semimacronematous, mononematous, straight or flexuous, hyaline, smooth, with a terminal verticil of up to eight conidiogenous cells; conidiogenous cells also produced in groups of two to six laterally, immediately below transverse septa towards the distal end. Conidiogenous cells monophialidic, discrete, arranged verticillately, determinate, more or less narrowly cylindrical, attenuating gradually towards the tip, 15-35 X 1-2µ. Conidia enteroblastic, produced in basipetal succession at the tips of the phialides, variable, oval to ellipsoid, hyaline, smooth, non-septate, 2-10 X 1-2µm.

On carpophores of members of the Agaricales; Europe and North America.

Collection examined: isolated from *Agaricus bisporus* (Large) Imbach, P.J. Wuest, ATCC 32849; on *Pleurotus sapidus* (Schulzer) Kalch., Auburn, Lee County, Alabama, August 7, 1978, D.J. Gray, AUA.

ACKNOWLEDMENTS

We have had the benefit of consultation with Drs. Günter R.W. Arnold, Friedrich-Schiller-Universität Jena, Weimar, East Germany and Walter Gams, Centraalbureau voor Schimmelcultures, Baarn, The Netherlands, concerning several matters taxonomic. Both of these gentlemen have also provided us with cultures of several mycoparasitic hyphomycetes. Dr. Richard T. Hanlin, University of Georgia,reviewed the manuscript and offered helpful suggestions for which we are grateful.

REFERENCES

ARNOLD, G.R.W. 1970. Uber *Sibirina* und *Sympodiophora* zwei neue gattungen der Moniliales. Nova Hedwigia 19: 299-304.

BARRON, G.L. 1969. The genera of Hyphomycetes from soil. Williams and Wilkins, Baltimore: 1-364.

COLE, G.T. and W.B. KENDRICK. 1971. Conidium ontogeny in hyphomycetes. Development and morphology of *Cladobotryum*. Can. J. Bot. 49: 595-599.

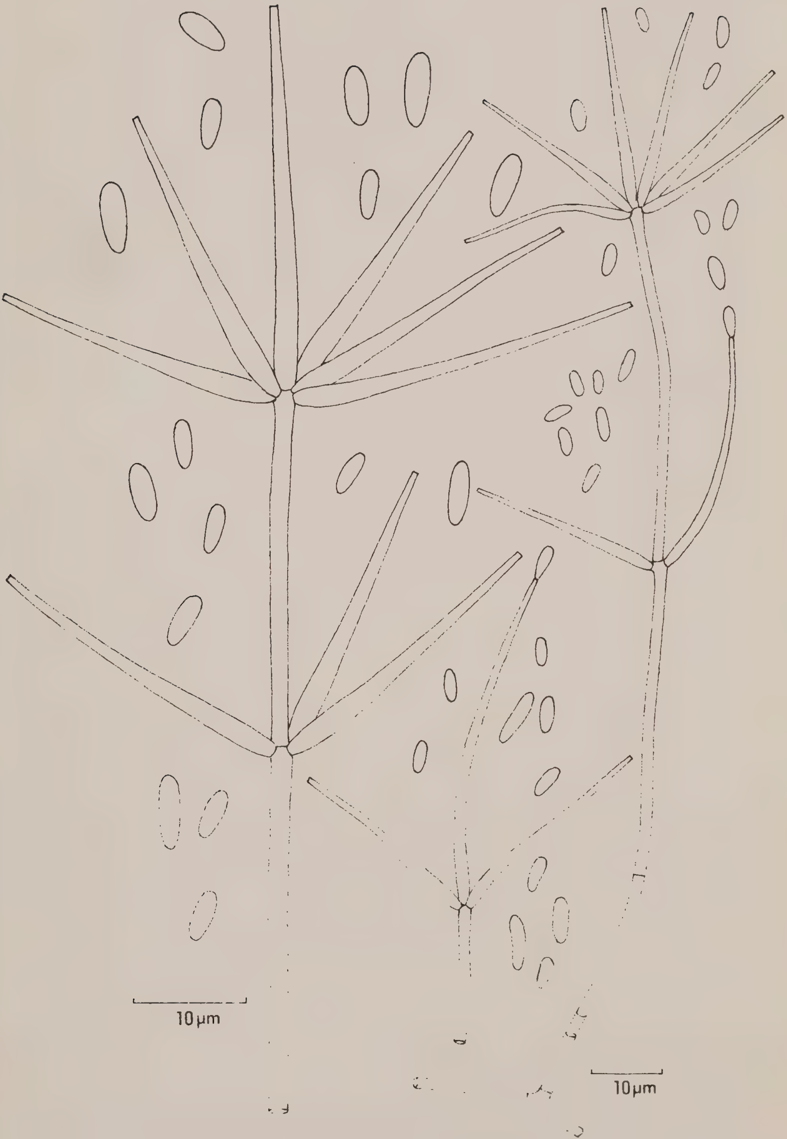


FIGURE 13. *Verticillium fungicola*

GAMS, W. 1973. Phialides with solitary conidia? Remarks on conidium ontogeny in some hyphomycetes. Persoonia 7: 161-169.

GAMS, W. and A.C.M. HOOZEMANS. 1970. *Cladobotryum*-konidienformen von *Hypomyces*-arten. Persoonia 6: 95-110.

GRAY, D.J. 1979. Some mycoparasitic Hyphomycetes. M.S. thesis, Auburn University: 1-135.

HASHMI, M.H. 1977. Conidium ontogeny in Hyphomycetes: The holoblastic conidia of *Hypomyces roseus* (= *Cladobotryum mycophilum* (Oudem.) W. Gams & Hoozem.) Pak. J. Bot., 9: 115-118.

KENDRICK, B. 1971. Arthroconidia and meristem arthroconidia. Taxonomy of the Fungi Imperfecti. Ed. B. Kendrick. Univ. Toronto Press: 160-175.

KENDRICK, W.B. and G.T. Cole. 1969. Conidium ontogeny in *Trichoderma roseum* and its meristem arthrospores. Can. J. Bot. 47: 345-350.

MORGAN-JONES, G. and D.J. GRAY. 1979. Notes on Hyphomycetes. XXVII. *Mycogone psilocybina*, a new mycoparasitic species. Mycotaxon 8: 144-148.

MYCOTAXON

Vol. X, No. 2, pp. 405-408 January-March 1980

NOTES ON HYPHOMYCETES. XXXV.
STENELLOPSIS GEN. NOV.

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ABSTRACT

Heterosporium magnoliae Weedon, is relassified in a new genus, *Stenellopsis* Morgan-Jones, and is described and illustrated from its type material and collections made in Alabama.

INTRODUCTION

The fungus known as *Heterosporium magnoliae* Weedon, which is common in the southeastern United States as black sooty blotches on the abaxial surface of leaves of *Magnolia grandiflora* L., cannot properly remain classified under *Heterosporium* Klotzsch [lectotype species *H. ornithogali* Klotzsch (Hughes, 1958), ≡ *Cladosporium ornithogali* (Klotzsch) de Vries] since this name is now considered a synonym of *Cladosporium* Link ex Fr.

Recent collections of *H. magnoliae* from Alabama and access to its type material have afforded an opportunity to redescribe and illustrate the species. Unlike *H. ornithogali* it does not bear the characteristics of the genus *Cladosporium*. Although resembling *Stenella* Sydow in a number of ways, *H. magnoliae* cannot satisfactorily be classified in that genus either. It is sufficiently different from similar dematiaceous hyphomycetes as to necessitate the establishment of a new genus in which to accommodate it.

TAXONOMIC PART

Stenellopsis gen. nov.

Deuteromycotina, Hyphomycetes.

(Etym. *Stenella* et Gr. *opsis*, aspect)

Coloniae effusae, fuscae vel atrae. Mycelium superficiale, ex hyphis repentibus, ramosis, septatis, pallide brunneis, verruculosis compositum. Conidiophora semimacronemata vel macronemata, mononemata, simplicia vel ramosa, recta vel flexuosa, septata, pallide brunnea vel brunnea, verruculosa. Cellae conidiogenae monoblasticae vel polyblasticae, in conidiophoris incorporatae, cylindricae. Conidia solitaria, sicca, septata, pallide brunnea, cylindrica, verruculosa.

Species typica: *Stenellopsis magnoliae* (Weedon) Morgan-Jones

Colonies effuse, brown to black. Mycelium superficial, composed of repent, branched, septate, pale brown, verruculose hyphae. Conidiophores semimacronematous to macronematous, mononematous, simple or branched, straight or flexuous, septate, pale brown to brown, verruculose. Conidiogenous cells monoblastic or polyblastic, integrated, terminal or intercalary, cylindrical. Conidia solitary, dry, septate, pale brown, cylindrical, verruculose.

Stenellopsis magnoliae (Weedon) comb. nov. (Fig. 1).

≡ *Heterosporium magnoliae* Weedon, Mycologia 18: 222, 1926.

Colonies abundant, hypophyllous, brownish-black, sooty in appearance, suborbicular with a ragged margin or irregular in shape, discrete or confluent, densely gregarious or, less frequently, scattered, up to 2.5cm. in diameter. Mycelium effuse, superficial, composed of pale brown, repent, much branched, septate, verruculose, 2.5-3.5μm wide hyphae, forming a dense network. Conidiophores semimacronematous to macronematous, mononematous, arising terminally on and as lateral branches of the mycelial hyphae, usually numerous, simple or, more frequently, branched, straight or flexuous, pale to mid brown, cylindrical, frequently with nodose swellings that are sometimes unilateral in arrangement, verruculose, up to 480μm long, 3-4.5μm wide. Conidiogenous cells monoblastic or polyblastic, integrated, terminal and sympodial or intercalary, conidial scars thin and inconspicuous; if intercalary inflated at the conidiogenous loci which usually occur immediately below transverse septa to give a nodose appearance. Conidia solitary, dry, cylindrical, straight or slightly curved, pale brown, verruculose to rugulose, 1 to 5, or rarely 7-septate, broadly obtuse towards the apex, attenuated towards a narrow, subhyaline, truncate, unthickened hilum, 14-48 X 3.5-4.5μ.

On dead leaves of *Magnolia grandiflora* L.; North America.

Collections examined: on *M. grandiflora*, St. Petersburg, Florida, February 15, 1923, A.G. Weedon, BPI, type; on *M. grandiflora*, Auburn, Lee County, Alabama, May 3, 1976,

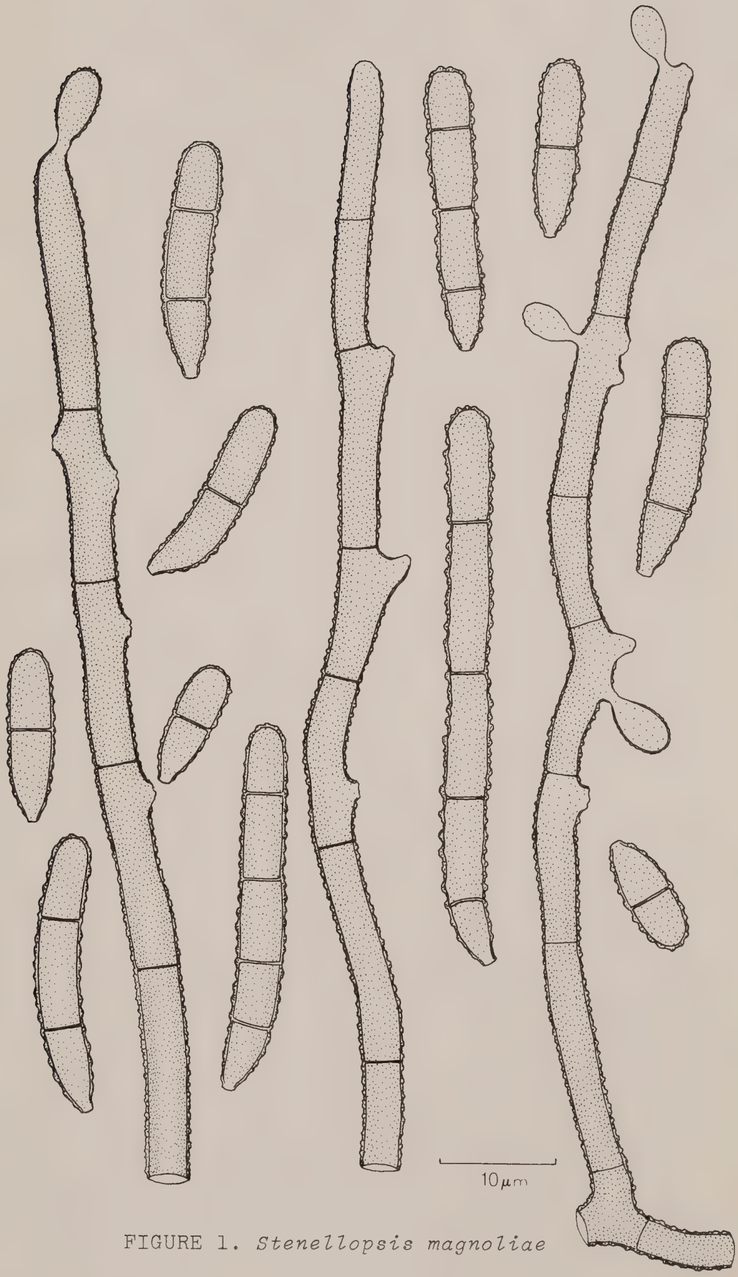

FIGURE 1. *Stenellopsis magnoliae*

G. Morgan-Jones, AUA; on *M. grandiflora*, Auburn, Lee County, Alabama, May 1976, L.G. Brown, AUA; on *M. grandiflora*, Montgomery, Montgomery County, Alabama, May 1979, G.W. Karr, Jr., AUA.

Stenellopsis differs from *Stenella*, which it most closely resembles, in a number of respects, most notably in the location of conidiogenous loci in relation to conidiophore growth. In the latter, successive conidia are formed terminally as a result of serial sympodial proliferation. Only rarely do conidiogenous cells become intercalary as a result of distal extension by proliferation and subsequent delimitation of the apical portion by the laying down of a transverse septum. *Stenellopsis* conidia are formed at numerous intercalary meristematic loci in an irregular sequence and, at least in part, retrogressively. A number of conidiogenous cells may thereby become conidiogenous. In this respect *Stenellopsis* appears to be unique among fungi of broadly similar morphology. The conidiophores of *Fulvia* Ciferri, based on *F. fulva* (Cooke) Ciferri [≡ *Cladosporium fulva* Cooke], have a tendency to exhibit the same growth pattern and, interestingly, also bear unilateral, nodose swellings. Additional features that distinguish *Stenellopsis* from *Stenella* are its densely verruculose conidiophores and the absence of thickened, conspicuous scars marking the conidiogenous loci.

Weedon (1926) recognized the uniqueness of *S. magnoliae* and even suggested that it might best be placed in a separate genus, based on the fact that it is superficial on leaves.

ACKNOWLEDGMENTS

I thank Mrs. Flora G. Pollack, Agricultural Research Center, Beltsville, Maryland, for allowing me access to the type material of *H. magnoliae*. Dr. Roger D. Goos, University of Rhode Island, kindly reviewed the manuscript.

REFERENCES

HUGHES, S.J. 1958. Revisiones hyphomycetum aliquot cum appendice de nominibus rejiciendis. Can. J. Bot. 36: 727-836.

WEEDON, A.G. 1926. Some Florida fungi. Mycologia 18: 218-223.

MYCOTAXON

Vol. X, No. 2, pp. 409-412 January-March 1980

NOTES ON THE GENUS SUBULICYSTIDIUM

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Subulicystidium was erected by Parmasto in 1968 and was characterized by its arachnoid to cottony-textured fruitbody, distinct, loosely interwoven, clamped hyphae, subulate cystidia with thickened walls, and fusoid spores. The genus is typified by the well known species *Peniophora longispora* Pat. Jülich (1969) added an important character to the generic description when he reported that repetobasidia are produced by *P. longispora* and *P. nikau* G. H. Cunn. My own interpretation of the generic limits suggests that the minimum complement of characters that a taxon should possess in order to be included in *Subulicystidium* would be: long, subulate cystidia with ribbon-shaped wall ornamentation, repetobasidia, loosely interwoven, clamped hyphae, and an arachnoid to cottony-textured fruitbody.

In 1975, Jülich published several excellent SEM micrographs illustrating the wall ornamentation of the cystidia. He reported that the ornamentation was composed of two rows of "ribbon-like" structures rather than four rows of regularly spaced short crystals. His micrographs leave little doubt that the cystidial wall ornamentation is formed by the deposition of wall material rather than the accumulation of crystals. That interpretation is important in the following discussion regarding the taxonomic limits of the genus.

Peniophora ralla H. S. Jackson has been recently transferred to *Subulicystidium* by Hjortstam and Ryvarden (1979). The crystal-coated cystidia of *P. ralla* are morphologically similar to the previously included species of *Subulicystidium* but lack the ribbon-like ornamentation of wall material illustrated by Jülich. In evaluating this difference, I have concluded that the accumulation of crystals on cystidial walls represents a type of ornamentation that is not homologous to the production of morphologically stable wall deposits. Since *P. ralla* also lacks repetobasidia (Hjortstam and Ryvarden 1979), it therefore deviates significantly from the other species within the genus.

Circumscribing the taxonomic limits of each species of *Subulicystidium* is also a difficult enterprise due to the extreme variability in spore size and morphology that one encounters within individual collections and among collections. Oberwinkler (1977) has provided one of the first detailed discussions concerning these difficulties. He reported two collections (FO 17359, 17371) with long, narrow spores that possibly represent a new species and two Venezuelan collections (FO 15970, 16014) whose spore length is between those reported for *S. longisporum* (Pat.) Parm. and *S. brachysporum* (Talbot and Green) Jülich. He also described *S. meridense* and *S. naviculum* as new species.

In an attempt to better understand the magnitude of variability found among spores in collections that could be assigned to *Subulicystidium*, I have calculated a length-to-width ratio for spores observed in the type collections of *P. longispora* Pat. var. *brachyspora* Talbot and Green, *P. nikau*, and in specimens collected from a single geographic area (Venezuela) by Liberta and Navas (1978). Twenty spores from each collection were measured, a ratio calculated for each spore, and a range of ratios recorded for each collection. These ratios are illustrated in Figure 1 and they depict a continuum, each ratio overlapping a few collections with shorter spores as well as a few with longer spores. The continuum begins with ratios representing the spores of *S. nikau* and ends with a collection whose spores are longer and narrower than those reported for the type of *P. longispora* (Oberwinkler 1977). In addition, various ratios along this continuum represent the relative positions of several species that have been described by previous investigators. For example, ratios *e* and *m* represent collections whose spores are very similar to those reported for the type collections of *S. meridense* and *S. longisporum*, respectively. Also, ratio *p* represents a collection similar in spores size to FO 17359 cited by Oberwinkler (1977). Of greatest importance to this discussion, however, are the numerous "intermediate" collections whose taxonomic disposition among the described species is unclear. For example, Figure 1 includes seven collections whose spore sizes and ratios are intermediate between ratio *e*, representing *S. meridense*, and ratio *m*, representing *S. longisporum*.

It is interesting to note that a similar continuum of spore size

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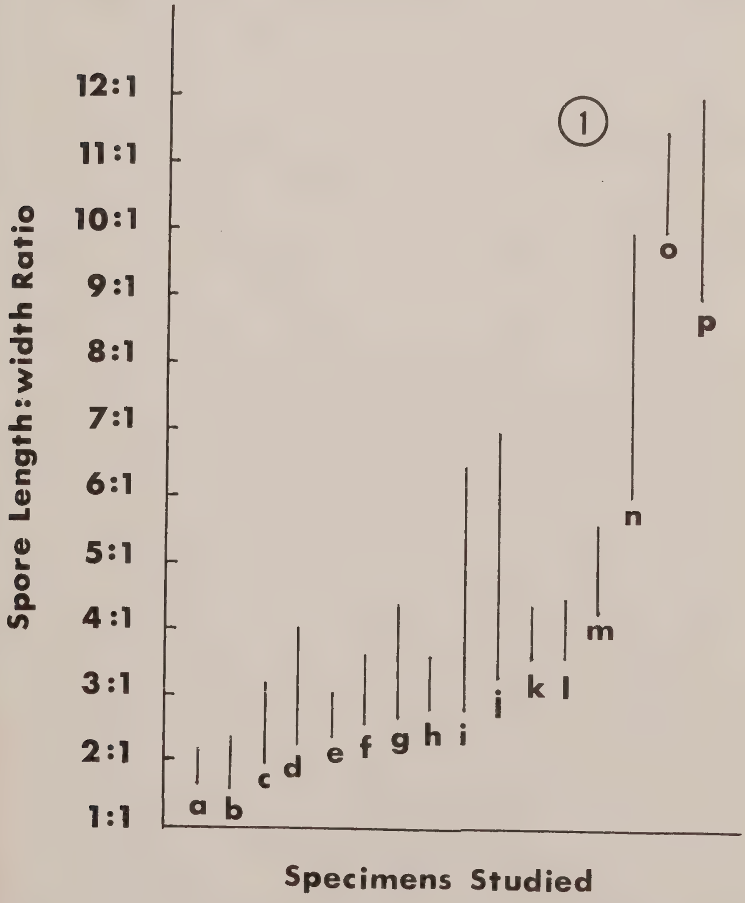
Fig. 1 Length-to-width ratios for spores of type specimens and Venezuelan collections representing taxa of *Subulicystidium*. *a:* Venezuelan collections identified as *S. nikau*, spores 5-9 x 3-3.5 µm (ISU 1421, 1487, 1488, 1590); *b:* Isotype of *S. nikau*, spores 6.5-8.5 x 3.5-4.5 µm (K); *c:* Holotype of *Peniophora longispora* var. *brachyspora*, spores 6.5-8 x 2.5-3 µm (PREM); *d:* six Venezuelan collections identified as *S. brachysporum*, spores 7-11 x 2.5-3.5 µm (ISU 1465, 1467, 1468, 1600, 1603, 1605); *e:* collections identified as *S. meridense*, spores short, cylindrical to suballantoid, 6-7 x 2.5 µm (ISU 1597, 1618); *f:* collection with spores short, cylindrical, 6.5-9 x 2.5 µm (ISU 1478); *g:* collection with spores, moderately long, fusiform, 8-11 x 2.5-3 µm (ISU 1575); *h:* collection with spores either short-cylindrical 7-9 x 2.5 µm, or fusiform, 9.5-10 x 3 µm (ISU 1466); *i:* collection with spores moderately long, cylindrical, 7-13 x 2-2.5 µm (ISU 1622); *j:* collection with spores moderately long, fusiform, 10-13.5 x 2-3 µm (ISU 1623); *k:* collection with spores moderately long, cylindrical, 9-11 x 2.5 µm (ISU 1420); *l:* collection with spores moderately long, fusiform, 9-9.5 x 2-2.5 µm (ISU 1604); *m:* collection identified as *S. longisporum*, spores moderately long, fusiform, 13-15 x 2-2.5 µm (ISU 1470); *n:* collection with spores long, cylindrical to filiform, 14-17 x 1.5-2.5 µm (ISU 1609); *o:* collection with spores long, cylindrical to filiform, 20-23 x 2 µm (ISU 1613); *p:* collection with spores long, cylindrical to filiform, 15.5-18 x 1.5-2 µm (ISU 1607).

extremes in *Xerulina asprata* (Berk.) Pegler has been reported by Redhead and Ginns (pers. com.). Steyaert (1975) has also reported a wide range of spores sizes in *Ganoderma tornatum* (Pers.) Bres.

Caution should be exercised when dealing with taxa of *Subulicystidium* until additional data generated by compatibility studies, culture characterization, and disc electrophoresis clarify the species limits. In the meantime, and solely based upon morphological characters, I have concluded that *S. nikau* and possibly *S. naviculum* represent distinct species, but *S. brachysporum*, *S. longisporum*, *S. meridense*, and the "intermediates" noted in Figure 1 belong to a single species complex.



LITERATURE CITED

HJORTSTAM, K., and L. RYVARDEN. 1979. Notes on Corticiaceae (Basidiomycetes) IV. Mycotaxon 9: 505-519.

JÜLICH, W. 1969. Uber die Gattungen *Piloderma* gen. nov. und *Subulicystidium* Parm. Ber. Deutsch. Bot. Ges. 81: 414-421.

JÜLICH, W. 1975. Studien an Cystiden -I. *Subulicystidium* Parm. Persoonia 8: 187-190.

LIBERTA, A. E., and A. NAVAS. 1978. Notes on Venezuelan Corticiaceae (Basidiomycetes). Can. J. Bot. 56: 1777-1781.

OBERWINKLER, F. 1977. Species-and generic-concepts in the Corticiaceae. Pages 331-348 in H. Clémençon, ed. The species concept in Hymenomycetes. J. Cramer, Vaduz.

PARMASTO, E. 1968. Conspectus systematus Corticiacearum. Tartu.

STEYAERT, R. L. 1975. The concept and circumscription of *Ganoderma tornatum*. Trans. Br. Mycol. Soc. 65: 451-467.

MYCOTAXON

Vol. X, No. 2, pp. 413-420 January-March 1980

THREE NEW ENDOMYCORRHIZAL *GLOMUS* SPP. ASSOCIATED WITH ACTINORRHIZAL SHRUBS

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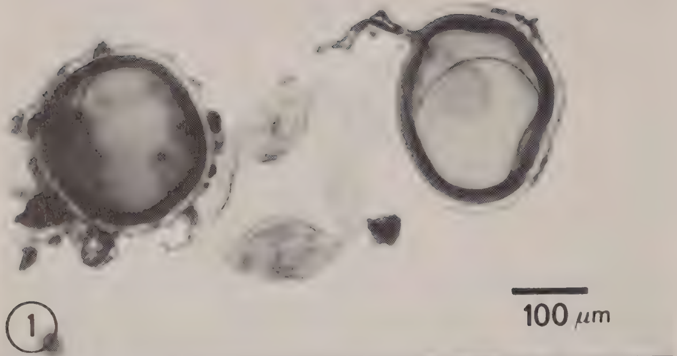
In assessing mycorrhizal associations of non-leguminous dinitrogen-fixing (actinorrhizal) plants, we sampled soil for Endogonaceae by wet-sieving and decanting (Gerdemann and Nicolson, 1963) as modified by Smith and Skipper (1979). The three new species described below were associated with actinorrhizal shrubs in central Oregon and coastal England. The collections are deposited in the herbarium of Oregon State University (OSC).

GLOMUS HALONATUS Rose & Trappe sp. nov. (Figs. 1-3)

Chlamydosporae singulae vel laxe fasciculatae in solo efformatae, globosae vel subglobosae, 200-280 μm in diam, brunneolae vel tabacinae. Sporae tunica 18-35 μm crassa, stratis duobus: exteriore 8-12(-20) μm crasso, hyalino, mucilagino, juventute laevi, deinde scabro; interiore 10-15 μm crasso, brunneo, lamellato, minute echinulato. Hypha affixa ad tunicam sporae constricta, infra constrictionem inflata, septo.

Chlamydospores borne singly in soil or in small, loose clusters of 3-7 spores within a loosely wefted peridium, globose to subglobose, 200-280 μm in diam, light brown to brown. *Spore walls* 18-35 μm thick, of two layers: the outer 8-12 (-20) μm thick, hyaline, amorphous, sometimes with obscure radial striations, in youth smooth, with age becoming roughened; the inner 10-15 μm thick, brown, often prominently lamellate, ornamented with crowded spines 0.5 x 0.2 μm that extend into the outer layer. Old spores sometimes with a third dark brown innermost layer ± 5 μm thick. *Attached hypha* straight, extending through the outer hyaline wall wherein it is constricted to 5-6 μm in diam. At the surface of the outer hyaline wall, subtending hypha expanded to 11-13 μm in diam, and at ± 10 μm below the outer hyaline wall inflated to as much as 17 μm in diam; hyphal walls near the spore totaling 5-8 μm thick, with a thick hyaline outer layer and a thin brown inner layer; hypha often with a septum ± 30 μm below the attachment. *Spore contents* of oil globules of varying size.

DISTRIBUTION AND HABITAT: Central Oregon in arid, volcanic soils, in sand dunes in coastal England, and grasslands in Veracruz, Mexico.



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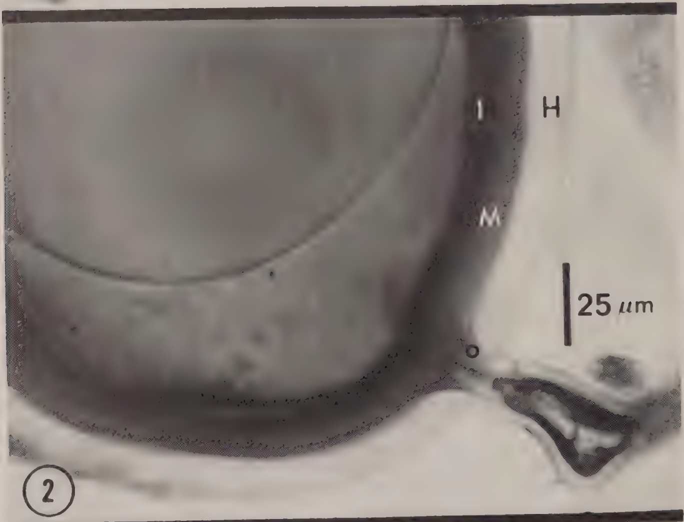

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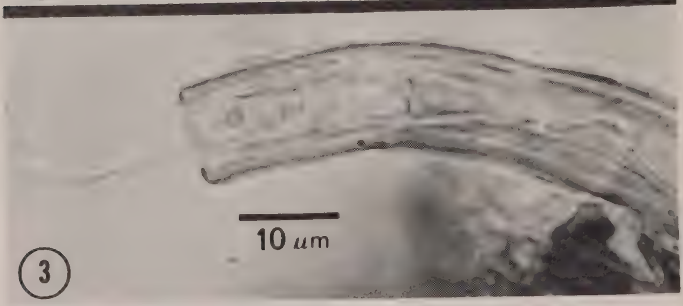

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MYCORRHIZAL ASSOCIATIONS: Associated in the field with vesicular-arbuscular (VA) mycorrhizae of *Ceanothus velutinus* Dougl. and *Hippophae rhamnoides* L.

ETYMOLOGY: Latin, "haloed"; in transmitted light in optical cross section, the thick, hyaline outer spore wall appears as a bright ring around the spore.

COLLECTIONS EXAMINED: HOLOTYPE-ENGLAND, Lincolnshire, Gibralter Point, under *Hippophae rhamnoides*, Nov. 1978, col. C. T. Youngberg, Rose S-225 (OSC). PARATYPE - UNITED STATES, Oregon, Deschutes Co., under *Ceanothus velutinus*, May 1979, Rose S-250. Mexico - Veracruz, with roadside grasses, 1977, no. 3594.

Glomus halonatus differs from *G. caledonius* (Nicol. & Gerd.) Trappe & Gerd. in having an amorphous poorly separable outer wall and echinulate inner wall vs. the nonmucilagenous, separable outer wall and smooth inner wall of the latter. The echinulations of the inner wall of *G. halonatus* resemble those of *G. monosporus* spores which, however, have but a thin outer wall, a hyphal mantle partially to totally enclosing the spore, and a subtending hypha that typically recurves along the spore surface. The spores of *G. halonatus* are cyanophilous in cotton blue but do not react distinctively to Melzer's reagent. The halo effect created by the outer wall in transmitted light in optical cross section is striking. The radial striations in the outer wall appear to extend from the spines on the inner wall and can be seen clearly only in some spores.

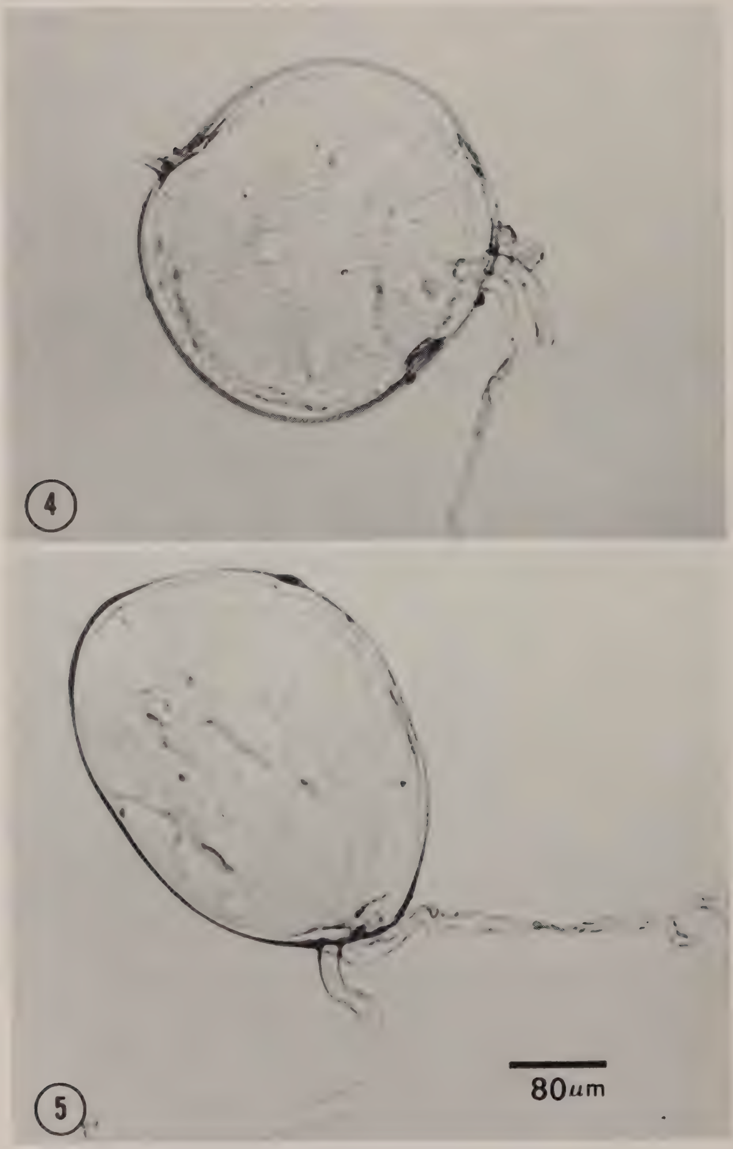
GLOMUS LACTEUS Rose & Trappe sp. nov. (Fig. 4 & 5)

Chlamydosporae singulae in solo efformatae, globosae vel subglobosae, 150-220 µm in diam, lacteae. Sporae tunica una, 3-5 µm crassa, hyalina, laevis. Hyphae affixae 1-3, 6-12 µm in diam, hyalina, tunicis parum incrassatis. Contentum sporae granulatum vel globulosum.

Chlamydospores borne singly in soil, globose to subglobose, 150-220 µm in diam, opaque, milky white, shiny smooth. *Spore walls* single, 3-5 µm thick, hyaline. *Attached hyphae* 1-3 per spore, 6-12 µm in diam, straight, hyaline, with walls slightly thickened only for a short distance from the spore; in most spores two hyphae merge near the spore to form a single attachment. *Spore contents* hyaline, granular or of globules of varying size.

DISTRIBUTION AND HABITAT: Central Oregon in arid, volcanic soil in edaphically stressed sites.

Figs. 1-3. *Glomus halonatus*. 1. Two mature spores in poly-vinyl-lactophenol (PVL) showing the typical outer "halo" as seen in transmitted light. 2. Wall layering in mature spores; (H) outermost hyaline layer forming a halo, (M) middle lamellate layer, and (1) inner layer found in mature specimens only. 3. Germination by regrowth of subtending hypha.



Figs. 4 & 5. *Glomus lacteus* with arrangement of two merging hyphae at the spore base and a third hypha situated some distance away.

MYCORRHIZAL ASSOCIATIONS: Associated in the field with VA mycorrhizae of *Ceanothus velutinus* and *Purshia tridentata* (Pursh) D.C. Forming VA mycorrhizae with *Bromus tectorum* L. in pot culture.

ETYMOLOGY: Latin, "milk-white", referring to the opaque milky appearance of the spores under incident light.

COLLECTIONS EXAMINED: TYPE: UNITED STATES, Oregon, Deschutes Co., 1 km north of Benham Falls, elev. 1100 m., 1-15 cm deep in soil under *Ceanothus velutinus*, April 1978, Rose S-210 (OSC). PARATYPE: Oregon, Deschutes Co., 1 km west of Pine Mtn., elev. 1500 m, 1-15 cm deep in soil under *Purshia tridentata*, Sept. 1978, Rose S-219 (OSC).

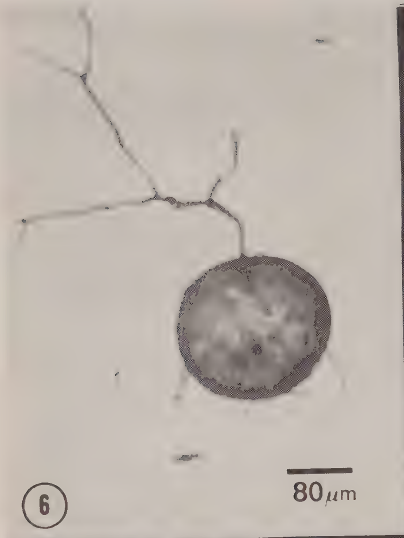
Glomus lacteus spores are distinctive in their combination of frequently multiple hyphal attachments, white color, and a thin, smooth, singly layered spore wall. Spores of *G. lacteus* closely resemble spores of *Glomus albidus* sp. nov. (Walker and Rhodes, manuscript in preparation) but can be differentiated by wall morphology. Young spores of *G. albidus* posses two walls of equal thickness, each 0.5-2.0 μm, whereas only one thin spore wall, 3-5 μm thick, appears on *G. lacteus* regardless of spore age. Spores of *G. albidus* and *G. clarus* both possess an outer spore wall that sloughs off at maturity, leaving a roughened outer surface on most spores. The spore wall of *G. lacteus* does not slough off; the spore surface is always smooth. *Glomus multicaulis* Gerd. and Bakshi spores frequently have more than one hyphal attachment but the spore walls are dark brown and ornamented with rounded projections in contrast to the white, smooth *G. lacteus* spores (Gerdemann & Bakshi, 1976). Occasional spores of other *Glomus* spp. have two hyphal attachments (e.g. *G. fasciculatus*, *G. microcarpus*, *G. monosporus*, *G. mosseae*, and *G. albidus*) but the phenomenon in these cases is atypical (Gerdemann & Trappe, 1974; Gerdemann & Bakshi, 1976; Walker and Rhodes, manuscript in preparation).

In *G. lacteus* two hyphae often grow parallel to each other for some distance, then merge near the spore to form a single attachment. Another hypha often is attached 10-20 μm away from the attachment point of the merged hyphae, and sometimes yet another hypha is attached at a still greater distance from that of the merged hyphae. These multiple attachments resemble the progametangia of zygospores of *Endogone multiplex* Thaxter (1922) and of some Kickxellaceae (Benjamin, 1966). It is thus possible that *G. lacteus* as we describe it is zygosporic rather than chlamydosporic. As presently circumscribed the genus *Endogone* contains only sporocarpic species and is not known to be VA mycorrhizal. The assignment of this new species to *Glomus* seems to be best until more is known of its life cycle.

GLOMUS SCINTILLANS Rose & Trappe sp. nov. (Figs. 6-9)

Chlamydosporae singulae in solo efformatae, globosae vel subglobosae, 180-210 μm in diam, hyaline. Sporae tunica 7-10 μm in diam, stratis tribus: exteriore 2-4 μm crasso, hyalino, nodulis congestis, hyalinis, 1-3 x 0.4 - 1.2 (-3) μm ornatis; medio 2-3 μm crasso, hyalino, ex strato exteriore separabili; interiore 2-3 μm crasso, ad stratum medium adherenti. Hypha affixa 7-9 μm in diam, hyalina.

Chlamydospores borne singly in soil, globose to subglobose, 180-210 μm in diam, hyaline. *Spore walls* 7-10 μm thick, of three layers; the outer 2-4 μm thick, hyaline, with a surface ornamentation of hyaline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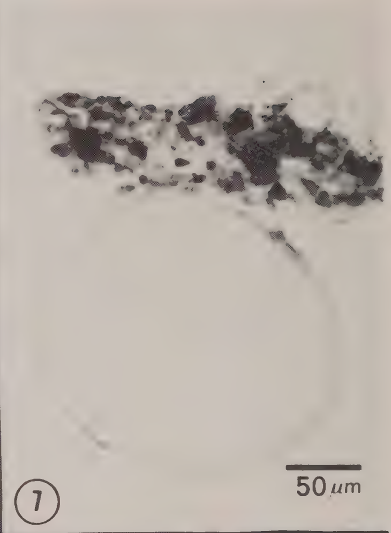
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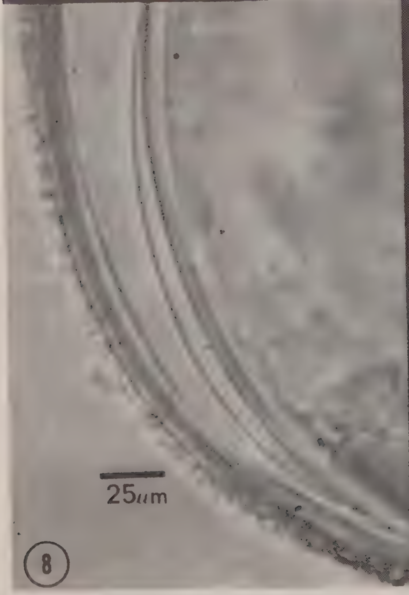
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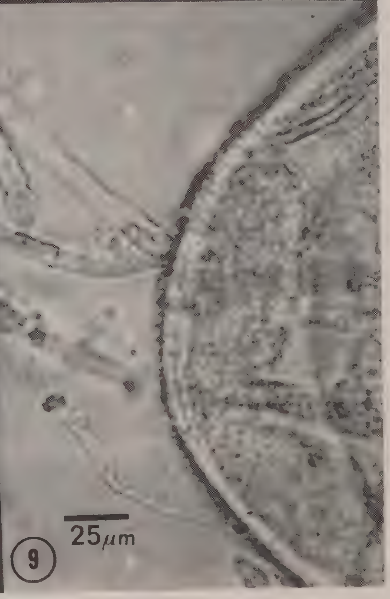
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knobs 1-3 x 0.4 - 1.2 (-3) µm; the middle layer 2-3 µm thick, hyaline, separable from the outer layer; and the inner layer, 2-3 µm thick, hyaline, adherent to the middle layer. *Attached hypha* straight, 7-9 µm in diam, hyaline; occasionally 2 hyphae merging near the spore to form a single attachment. *Spore contents* of hyaline globules 7-20 µm in diameter. Spores strongly cyanophilous in cotton blue but do not react distinctively to Melzer's reagent.

DISTRIBUTION AND HABITAT: Central Oregon in loamy pumice soil in desert areas with typically hot, dry summers.

MYCORRHIZAL ASSOCIATIONS: Associated in the field with VA mycorrhizae of *Cercocarpus ledifolias* Nutt. and *Purshia tridentata*.

ETYMOLOGY: Latin, "sparkling", referring to the way the spores sparkle under incident light due to reflections off the surface ornamentation.

COLLECTIONS EXAMINED: TYPE: UNITED STATES, Oregon, Lake Co., near Picture Rock Pass, 1500 m elev., 1-15 cm deep in soil under *Cercocarpus ledifolias*, Sept. 1978, Rose S-220 (OSC). PARATYPE: Oregon, Deschutes Co., 1 km west of China Hat Mtn., in soil under *Purshia tridentata*, May 1979, Rose S-251 (OSC).

Glomus scintillans closely resembles *Glomus clarus* in size and color, but differs in having a knobby surface, in lacking a bulging pore septum in the subtending hypha at the spore base, and the spores do not turn yellow with age as is commonly the case with *G. clarus*. It differs from *Complexipes moniliformis* gen. et sp. nov. (Walker, 1979) ("crenulate spore", Mosse & Bowen, 1968a) by its lack of color and hyphal septation.

Glomus scintillans will key out to spore WUM 4 (couplet #59) in the key to the Endogonaceae (Hall and Fish, 1979). No samples of WUM 4 were compared with *Glomus scintillans* spores for this description.

Spore germination is by hyphal extension directly through the spore wall (Fig. 9) as is commonly observed in *Glomus pallidus* and in species of *Gigaspora* (e.g. *G. margarita* and *G. rosea*).

ACKNOWLEDGEMENTS

Drs. B. Mosse and C. T. Youngberg kindly furnished spore collections from England. S. Morris, J. Fuller, M. Guilemette, and G. Spiro generously contributed their time and help during sampling periods. This is Technical Paper No. 5355, Oregon Agricultural Experiment Station. Facilities for

Figs. 6-9. *Glomus scintillans.* 6. Spore stained with Cotton Blue showing cyanophilous reaction and multiple hyphal attachments. 7. Spore in PVL, wall layering and surface ornamentation is visible. 8. Detail of surface protrusions and wall layering. 9. Germination directly through the spore wall; spore contents aggregates near the point of germination.

the research were provided by the U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory.

LITERATURE CITED

Benjamin, R. K. 1966. The merosporangium. Mycologia 58:1-42.

Gerdemann, J. W. and B. K. Bakshi. 1976. Endogonaceae of India: two new species. Trans. Br. Mycol. Soc. 66:340-343.

Gerdemann, J. W. and T. H. Nicolson. 1963. Spores of mycorrhizal *Endogone* species extracted from soil by wet sieving and decanting. Trans. Br. Mycol. Soc. 46:235-244.

Gerdemann, J. W. and J. M. Trappe. 1974. The Endogonaceae of the Pacific Northwest. Mycologia Mem. 5:1-76.

Hall, I. R. and B. J. Fish. 1979. A key to the Endogonaceae. Trans. Br. Mycol. Soc. (In press).

Mosse, B. and G. D. Bowen. 1968. A key to the recognition of some *Endogone* spore types. Trans. British Mycol. Soc. 51:469-483.

Smith, G. W. and H. D. Skipper. 1979. Comparison of methods to extract spores of vesicular-arbuscular mycorrhizal fungi. Soil Sci. Soc. Am. J. 43(4):722-725.

Thaxter, R. 1922. A revision of the Endogonaceae. Proc. Amer. Acad. Arts. Sci. 57:291-351.

Walker, C. 1979. *Complexipes moniliformis*: A new genus and species tentatively placed in the Endogonaceae. Mycotaxon 10(1):99-104.

MYCOTAXON

Vol. X, No. 2, pp. 421-427 January-March 1980

TERATOSPERMA OLIGOCLADUM, A NEW HYPHOMYCETOUS MYCOPARASITE ON SCLEROTIA OF SCLEROTINIA SCLEROTIORUM, S. TRIFOLIORUM, AND S. MINOR

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SUMMARY

A dematiaceous hyphomycete recently discovered in soil from California is illustrated and described as a new species, *Teratosperma oligocladum*. The primary conidia are phragmoseptate and are pentaradiate, having an elongate axis and three arms radiating from the second or third cell from the base. The fungus is mycoparasitic on sclerotia of *Sclerotinia sclerotiorum*, *S. trifoliorum*, and *S. minor*. It has a *Selenosporella* state and produces bulbils.

Sporidesmium sclerotivorum Uecker et al. (1978) was recently described as a dematiaceous hyphomycete that: 1) produces phragmoseptate conidia as blown-ends of the conidiophores, the conidiophores proliferating percurrently from the tip of the former penultimate cell through the broken terminal cell; 2) produces a *Selenosporella* state, often on the same hypha with the *Sporidesmium* state; and 3) occurs as a mycoparasite on sclerotia of

Sclerotinia sclerotiorum (Lib.) dBy. In this paper we report the discovery of another dematiaceous hyphomycete having the same characteristics enumerated above, but differing in several morphological features. We describe it here as a new species of *Teratosperma*.

Terminology regarding conidial development and structure follows the recommendations of Kendrick (1971). Names of herbaria are abbreviated according to the Index Herbariorum (Holmgren and Keuken, 1974).

Teratosperma oligocladum Uecker, Ayers, et Adams, sp. nov.

Coloniae super *Sclerotiniae sclerotiorum*, *S. trifoliorum*, et *S. minor* sclerotia efformantes. Hyphae 3-7µm latae, pallide vel mediocriter brunnescentes. Bulbilli 40-60µm diametro, nigri ubi in culturis super papyrum ad percolandum crescentes. Conidiophorum simplex, erectum, leve, diametro et colore idem atque hypha assimilitiva, aetate provectum obscurius, 2-4 cellulare, cellula terminali conidiogena, prolificatione probabiliter percurrente. Cellula conidiogena holoblastica, integrata. Conidium mediocriter brunneum, atrobrunneum vel fuscum, (130-)150-260(-390)µm longum, axis prolongatione hyalina inclusa; axis conidii multiseptatus, (0-)1-3(-4) ramis ex cellula secunda vel tertia supra basin exorientibus, 50-180 X 6-9 µm, apicem versus attenuatis, apice 2-3µm lato ornatus.

In hyphis eisdem ac *Teratosperma* vel sejunctis orta *Selenosporellae* fructificatio. Huius conidiophora simplicia vel ramosa, 45-152µm longa, ad basim 6-8µm lata, apicem versus 3-5µm lata. Cellulae conidiogenae indeterminatae, sympodiales, in verticillis binis vel septenis vel numero interjecentes e conidiophoro vel eius ramulis ortae, (15-)25-45(-52)µm longae, ad basim 3-5µm latae, apicem versus attenuatae, 1µm latae vel angustiores, parte terminali denticulas paucas vel multas conidiogenas producente. Loci conidiogeni multiplices, seriales, progredientes. Conidia hyalina, falcata vel fusiformia, utrinque rotundati, 7-8 X 1-1.5µm, in guttulae mucosae aggregatae.

Holotypus BPI 71912; isotypi in DAOM, NY, et IMI.

Etymology; Gr. oligo = few, klados = branch.

Colonies developing on sclerotia of *Sclerotinia sclerotiorum*, *S. trifoliorum*, and *S. minor*. Hyphae 3-7µm wide, light or becoming medium brown. Bulbils 40-60µm

diameter, black when growing on filter paper. Conidiophore simple, erect, smooth, the same diameter and color as the assimilative hypha, becoming darker with age, 2-4 cells long, terminal cell conidiogenous, probably proliferating percurrently. Conidiogenous cell holoblastic, integrated. Conidium medium brown or dark brown or fuscous, (130-)150-260(-390)μm long including the hyaline prolongation of the axis, axis of the conidium multiseptate, adorned with (0-)1-3(-4) limbs developing from the second or third cell above the base, limbs 50-180 X 6-9μm, attenuate toward the apex, apex 2-3μm wide.

Selenosporella state and Teratosperma state developing on the same hypha or on different ones. Conidiophore of Selenosporella state simple or branched, 45-142μm long, 6-8μm wide at base, tapering to 3-5μm at apex. Conidiogenous cells indeterminate, sympodial, arising in whorls of up to 7 from the conidiophore or its branches, (15)25-45(-52)μm long, 3-5μm wide at base, attenuate toward the apex, terminal part 1μm wide or less, producing few or many conidiogenous denticles. Conidiogenous loci multiple, serial, progressive. Conidia hyaline, falcate or fusiform, ends rounded, 7-8 X 1μm, aggregated in mucous droplets.

Teratosperma oligocladum was collected from soils obtained from farms near Salinas and Tulelake, California. Soil samples taken from fields having a history of Sclerotinia infestations were baited with sclerotia obtained from cultures on autoclaved oat seeds. Sclerotia were transferred to moist filter paper at 4- week intervals. The fungus appeared on sclerotia removed from the soil sample after 4 weeks incubation. It grew onto the filter paper and was identifiable after 7-10 days, and continued producing conidia for several weeks. The first plates contained mostly the Teratosperma state, whereas in later transfers the Selenosporella state was preponderant. For routine cultivation in the laboratory, infested sclerotia were placed on water agar. On this medium the Selenosporella state developed profusely, whereas the Teratosperma state developed much less readily. The fungus also grew on sclerotia of S. trifoliorum Erickss. and S. minor Jagger (Fig. 1) on moist filter paper but has not been tested on sclerotia of other fungi. Its potential as a biological control agent against the sclerotia of species of Sclerotinia is under study.

Conidia of the Teratosperma state develop as blown-out ends of the terminal cell of the conidiophore. The radiating arms develop as simple extensions from the distal part of the second or third cell above the point of attachment of the conidium to the conidiophore. The arms become elongate, attenuate, and septate (Figs. 2, 3, 4). At maturity the main axis of the condium may be as much as 310μm long, including the thin, terminal, non-septate appendage. Three arms usually radiate symmetrically from the axis of the conidium. Sometimes arms fail to develop or only one or two form. Sometimes a fourth arm develops (Fig. 4) from the first or second cell above the others. The Selenosporella state (Fig. 6) develops either on the same hypha (Fig. 7) as the Teratosperma state or on different hyphae. A reduced form of the Selenosporella state often develops in culture from any arm of the Teratosperma state conidia (Fig. 4).

The diagnostic feature of T. oligocladum is its large, dematiaceous, holoblastic, phragmoseptate, usually pentaradiate conidia that develop as blown-out ends of conidiophores, which probably proliferate percurrently. Other distinctive characteristics include the possession of a Selenosporella state (Figs. 6, 7, 8); the production of bulbils (Fig. 9); and the mycoparasitic habit on sclerotia of Sclerotinia sclerotiorum.

It is an assumption, but a reasonable one, that the conidiophore proliferates percurrently. The conidiophore looks like those of Sporidesmium subulatum (Cke. & Ellis) Hughes and S. sclerotivorum, both when the conidum is attached and after it has seceded. Furthermore, some conidiophores begin to proliferate through the tip of the former penultimate cell of the conidiophore (Fig. 5). However, we have not yet observed an undisputed example of percurrent conidiophore proliferation in this fungus.

The unique conidia of this fungus allow us only two viable taxonomic options. It would be reasonable to describe it as the sole member of a new genus. The other option, the one we have chosen, is to place this fungus in the genus Teratosperma as a new species. Members of only a few genera produce conidia as blown-out ends of the conidiophores and produce conidiophores that proliferate percurrently. Of the genera that do both, only Chaetendophragmia and Teratosperma have phragmoseptate conidia

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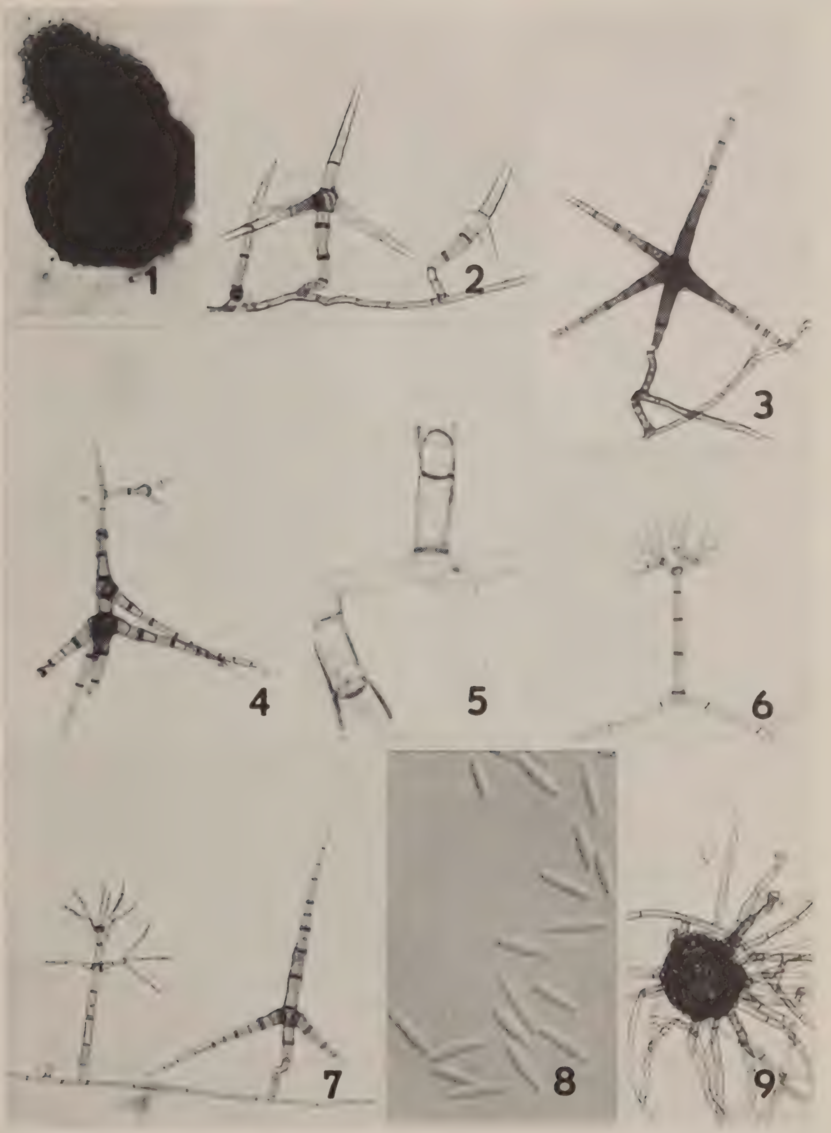
Figs. 1-9. Teratosperma oligocladum. Fig. 1. Conidia on sclerotium of Sclerotinia minor, X75. Fig. 2. Young conidia, one showing the origin of two radiating arms, X220. Fig. 3. Mature conidium, X220. Fig. 4. Mature conidium with extra arm; Selenosporella state formed on



two arms, X220. Fig. 5. Beginning of percurrent proliferation of conidiophore, X1000. Fig. 6. *Selenosporella* state, X220. Fig. 7. *Teratosperma* and *Selenosporella* states developing from the same hypha, X195. Fig. 8. *Selenosporella* state conidia, X1000. Fig. 9. Bulbil, X220.

with appendages. In *C. triangularia* Mats., one to three appendages emerge from the fourth cell from the base but the appendages are thin, hyaline, and non-septate. In *C. triseptata* Mats., two or three thin, hyaline, non-septate lateral appendages arise from the base of the terminal, hyaline, non-septate appendage. Only *Teratosperma* has conidia with appendages that are septate. Even in this genus, only *T. singulare* Syd. (the type species) has septate appendages. In other species of *Teratosperma* the appendages develop from the basal cell of the conidium, whereas in *T. oligocladum* the appendages develop from the second or third cell from the base. Hughes (1971) believed that *Sporidesmium subulatum*, which has no appendages, belongs in *Teratosperma*. He apparently felt that all fungi in which an entire septum rather than a half septum is involved in conidial production belong in the same genus. This would include *T. oligocladum*.

The *Selenosporella* state of *Teratosperma oligocladum* is morphologically very similar to that of *Sporidesmium sclerotivorum*. The former has a tendency toward greater numbers of larger conidiogenous cells per whorl but the differences are not consistent. Uecker et al. (1978) discussed *Selenosporella* species and states. Sutton and Hodges (1977) presented a key to the five named species of *Selenosporella*, none of which has been associated with another conidial state. Sutton and Hodges (1978) described *S. verticillata* also.

ACKNOWLEDGMENTS

We thank D. P. Rogers for correcting the Latin description. We also thank J. L. Crane and Flora G. Pollack for their valuable opinions on the relationships of this organism and for reviewing the manuscript.

LITERATURE CITED

Holmgren, P. K., and W. Keuken. 1974. Index Herbariorum I. The herbaria of the world. 6th ed. Regnum Veg. 92: 1-397.

Hughes, S. J. 1971. Percurrent proliferations in fungi, algae, and mosses. Canad. J. Bot. 49: 215-231.

Kendrick, W. B. (ed). 1971. Taxonomy of the Fungi Imperfecti. Toronto, U. of Toronto Press. 309 pp.

Sutton, B. C., and C. S. Hodges, Jr. 1977. Eucalyptus microfungi miscellaneous hyphomycetes. Nova Hedwigia 28: 487-498.

Sutton, B. C., and C. S. Hodges, Jr. 1978. Eucalyptus microfungi *Chaetendophragmiopsis* gen. nov. and other hyphomycetes. Nova Hedwigia 29: 593-607.

Uecker, F. A., W. A. Ayers, and P. B. Adams. 1978. A new hyphomycete on sclerotia of *Sclerotinia sclerotiorum*. Mycotaxon 7:275-282.

MYCOTAXON

Vol. X, No. 2, pp. 428-454 January-March 1980

THE PENIOPHOROID FUNGI OF THE WEST INDIES

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-Abstract-

Thirty-seven taxa of peniophoroid fungi are reported from the West Indies. Of these, thirty are considered valid reports authenticated by fertile (spore-bearing) specimens. Seven are considered dubious because their reports are based on sterile (non-spore-bearing) specimens. A few of the dubious reports are based on sterile type, isotype, or paratype material. The thirty authenticated taxa are distributed into eight genera: *Amphinema (1), Hyphoderma (4), Hyphodontia (2), Peniophora (4), Phanerochaete (6), Subulicystidium* (2, one of which is a new species), *Tubulicrinis* (1), and *Xenasma (1),* and nine are listed as *"Peniophora"*. These nine cannot be considered true peniophoras, nor can they at present be transferred to more suitable genera.

That *Peniophora,* as used by Burt and some of his contemporaries, is an aggregation of unrelated species is well known to the present generation of mycologists. This has led to a certain awkwardness of treatment. The cystidia upon which *Peniophora sensu lato* is founded are often striking objects capable of easy detection. It seemed to us that grouping these cystidia-bearing resupinates together might facilitate identification of collections, especially at this stage of flux in both the taxonomy of *Peniophora s. l.* and in our developing knowledge of the mycoflora of the West Indies. At the same time some acknowledgement should be made of the taxonomic advances in the realinement of this heterogeneous group. We have, therefore, included genera which appear, in our eyes, to have merit. Where there does not appear to be a valid generic concept or where such a concept still seems vague, we have left the taxon under *"Peniophora"*. The interminable nomenclatorial changes occurring in today's mycological studies clearly shows that only two taxonomic categories can claim any degree of stability; the class and the species. Therefore, the species of peniophoroid fungi are listed alphabetically in this report according to their specific epithet. This is followed by the basionym, if different, and, finally, by the currently accepted synonyms in capital letters, if necessary. Obligate synonyms are listed in the same paragraph; facultative synonyms in a separate paragraph. Numbers without prefixes or names refer to collections by A. L. Welden on deposit in the Tulane University Herbarium (NO).

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KEY TO SPECIES

1. Context hyphae darkly pigmented; cystidia heavily incrusted 2
1. Context hyphae hyaline or dilutely pigmented . . . 5
    2. Basidiocarp with large embedded crystalline masses visible on the hymenial surface with a hand lens; spores 5.5-14.5 x 3.5-4.5µm . . . . PENIOPHORA CARNEA
    2. Basidiocarp lacking such crystalline masses . . 3
3. Dendrophyses present; basidiocarp generally loosening and curling away from the substrate; hymenial surface Natal Brown; spores 6-8 x 2.5-3µm . . . . PENIOPHORA VERSIFORMIS
3. Dendrophyses absent; basidiocarp not generally separable 4
    4. Basidiocarp with dark tints; rose lilac to grayish black; context hyphae dark brown and generally without a distinct basal zone of hyphae adjacent to the substrate; spores 7-9 x 3-3.5µm . . . . PENIOPHORA CINEREA
    4. Basidiocarp with brighter tints; orangish to rose gray; context hyphae more lightly pigmented and generally with a basal zone of ± loosely arranged hyphae adjacent to the substrate; spores 9 x 3.5-4µm . . . . PENIOPHORA VERSICOLOR

5. Cystidia soluble in 10% KOH, biradicate, with very thick walls, long-cylindrical, arising from basal hyphae and protruding beyond the hymenium; spores 6-8 x 1.5-2μm . . . . TUBULICRINIS GRACILLIMA

5. Cystidia not soluble in KOH. 6

   6. Basidia produced almost exclusively as lateral extensions of the prostrate hyphae of the very thin, waxy or subpellicular, dry, adnate basidiocarp;spores 7.5-14 x 2.5-3.5μm, lunate to falcate . . . . .XENASMA DUSSII

   6. Basidia produced as terminal ends of hyphae, without bifurcate, non-septate bases 7

7. Context hyphae with short lateral branches with terminal and median inflations which are often incrusted; spores 3.5-4.5 x 1.5-3μm. . . . ."PENIOPHORA" INFLATA

7. Context hyphae without such inflations 8

   8. Basidiocarp membranous, 2-layered with a well-developed loose subiculum in which hyphae are branched at ± right angles and are simple septate or with rare single, double,or multiple clamps in the subicular hyphae only 9

   8. Basidiocarp without the above combination of characters 15

9. Notable or slight color change in KOH, some bleaching afterwards 10

9. Bleaching or no color change in KOH 13

   10. Rhizomorphs present 11

   10. Rhizomorphs absent 12

11. Basidiocarp wine red in KOH, bleaching afterwards; hymenial surface yellow ochre to buff; with conspicuous concolorous rhizomorphs; spores 4-5 x 2-4μm . . . . PHANEROCHAETE FILAMENTOSA

11. Basidiocarp not wine red in KOH; hymenial surface bright yellow and slightly bleaching in KOH; with conspicuous yellow rhizomorphs; spores 3.5-4.5 x 2-2.5μm . . . . .PHANEROCHAETE BURTII

   12. Hymenial surface brick red, near maroon in KOH, not bleaching afterwards; cystidia 30 - 75 x 5-10μm, abundant, projecting ones generally unincrusted and with thin walls, embedded ones heavily incrusted and with thick walls; spores 4.5-6 x 2.5-3μm . . . . PHANEROCHAETE AFFINIS

   12. Hymenial surface near Topaz in KOH and bleaching afterwards; cystidia 30-52 x 5.5-9μm,abundant,conical, heavily incrusted, with thick walls,embedded and projecting; spores 4.5-8 x 3.5-4μm . . . . .PHANEROCHAETE HUILCA

13. Rhizomorphs present; cystidia simple septate, 60-130 x 9-11μm, incrusted with golden yellow and crystalline granules, with thin walls; spores 4.5-7 x 2-3μm . . . . PHANEROCHAETE SEPTOCYSTIDIA

13. Rhizomorphs absent 14

    14. Cystidia generally incrusted only toward the apex, 30-90 x 6-12μm, with walls-3μm thick; hymenial surface whitish, creamy, or light ochraceous, cracking and showing white subiculum; spores 4-6 x 2-3μm . . . . .PHANEROCHAETE CREMEA

    14. Cystidia heavily incrusted throughout, 74-151 x 12-20μm,fusiform, acuminate, with walls -7μm thick; hymenial surface tawny; spores 4.5-5.5 x 3.5-4.5μm. . . . . PHANEROCHAETE PHOSPHORESCENS

15. Cystidia aculeate, sometimes septate and clamped at the base;hyphae dilutely pigmented or hyaline; spores 4.5-6.0 x 3-5μm . . . . AMPHINEMA BYSSOIDES

15. Cystidia not aculeate; hyphae hyaline 16

    16. Basidiocarp very thin, arachnoid; cystidia needle-shaped; spores more than 12μm long . . .17

    16. Basidiocarp thin or thick, arachnoid or not, but cystidia not needle-shaped and spores 11μm or less in length 18

17. Cystidia with acicular crystals ensheathing the middle of the cystidium; spores 20-27μm long, with the distal end often coiled or twisted . . . . .SUBULICYSTIDIUM COCHLEUM

17. Cystidia with small flattened crystals distributed in longitudinal rows on the cystidium; spores 8-15μm long. . . . . SUBULICYSTIDIUM LONGISPORUM

    18. Hyphae distinct, clamped; cystidia elongate, sometimes incrusted, with relatively thin walls 19

    18. Hyphae not distinct,agglutinated, or if distinct, then basidiocarp waxy or waxy membranous and bright colored 26

19. Basidia clavate; hyphae thick-walled,clamped;cystidia incrusted; spores 4-6 x 3-3.5μm . ."PENIOPHORA" FLAVA

19. Basidia urniform, suburniform or ventricose, usually with large subulate and arcuate sterigmata, or if such sterigmata lacking, then with fibrous basidiocarp and hyphae with 3 branches at a septum 20

    20. Basidia relatively large, elongate urniform, suburniform, or ventricose, usually with large subulate and arcuate sterigmata 21

    20. Basidia relatively smaller; basidiocarp fibrous; hyphae with 3 branches at a septum 24

21. Stephanocysts present; spores 8-10 x 4.5-5µm . . . . HYPHODERMA TENUIS

21. Without stephanocysts. 22

  22. Cystidia septate, sometimes with clamps; spores 7.5-11 x 3.5-5µm.HYPHODERMA SETIGERA(cf.P.ASPERA)

  22. Cystidia without septa or with false septa . . 23

23. Spores 6-9 x 4-4.5µm. . . . . . HYPHODERMA ARGILLACEA

23. Spores 9-12 x 4-5µm . . . . HYPHODERMA PILISETA

  24. Spores 5-6 x 3-4µm . . . . ROGERSELLA SAMBUCI

  24. Spores 6-9 x 1.5-4µm 25

25. Cystidia 35-60µm long,emerging -15(-30µm *teste* Burt); Spores 6-8 x 3-4µm . . . ."PENIOPHORA" SACCHARI

25. Cystidia 70-120µm long, emergent -40µm; spores 7-9 x 1.5-2µm . . . . HYPHODONTIA SUBALUTACEA

  26. Cystidia with thin walls, incrusted or not;spores 4.5-6 x 2-3µm. . . . . . . "PENIOPHORA" LUDOVICIANA

  26. Cystidia with relatively thick walls, heavily incrusted (metuloids) 27

27. Basidiocarp in section showing an intermediate layer of interwoven rarely clamped hyphae between zone of ± parallel hyphae and the stratosely thickening hymenium;spores 3-4.5 x 2-3µm. . . . . "PENIOPHORA" SIMILIS

27. Basidiocarp in section without such an intermediate layer 28

  28. Without a well-defined basal zone of ± parallel hyphae devoid of cystidia. 29

  28. With a well-defined basal zone of ± parallel or tightly interwoven hyphae devoid of cystidia . 30

29. Cystidia 30-45 x 12-20µm; spores 4-5 x 2-3µm . . . . "PENIOPHORA" RAVENELII

29. Cystidia 40-85 x 8-20µm; spores 5-6 x 3-4µm . . . ."PENIOPHORA" ROUMEGUERII

  30. Cystidia not in tiers, i.e.,hymenium not thickening in stratose manner, tilted at different angles,70-120 x 15-25µm; spores 5-6.5 x 2.5-4µm . . . . "PENIOPHORA" FLAVIDO-ALBA

  30. Cystidia in tiers, i.e., hymenium thickening in stratose manner; cystidia 40-85 x 8-20µm; spores 5-6 x 3-4µm. . . . . . ."PENIOPHORA" ROUMEGUERII

1. *Peniophora affinis* Burt, Ann. Missouri Bot. Gard. 12: 266. 1925 (1926); PHANEROCHAETE AFFINIS (Burt) Parm., Consp. Syst. Cort. 84 1968. *Vide* Rogers & Jackson, Farlowia 1: 318. 1943.

Membranous, separable, ca. 300-400µm thick;surface pruinose, orange-tan, turning red when wet with alkali; margin fimbriate, thinning, distinct, lighter than the surface. Hyphae compact, branching ± at right angles, with single and multiple clamps; basal hyphae ± parallel to the substrate, thick-walled, some incrusted, up to 10µm in diam; subhymenial hyphae narrower, thin-walled, ca. 3µm in diam. Cystidia 33-85 x 2-8µm, thick-walled, subulate, incrusted. Basidia 19.5-50 x 4.5-5.5µm; 4 slender sterigmata. Spores 4.5-6 x 2.5-3.5µm, ellipsoid.

Specimens examined: Cuba [C.J. Humphrey 2805 as *P. laevis* (Fr.) Burt in NY]; Vermont (E. A. Burt TYPE in FH); St. Lucia (2018, 2019).

Illustration: Gilbertson, R.L. Fungi that Decay Ponderosa Pine. Univ. of Arizona Press, p. 168, fig. 208. 1974.

2. *Peniophora argillacea* Bres., Fungi Trid. 2 : 63.1898; HYPHODERMA ARGILLACEA (Bres.) Donk,Fungus 27:15.1957.

Floccose-arachnoid to pelliculose, 40-90µm thick, grayish white or yellowish, tinted brown in spots, often in discontinuous patches; surface distinctly pilose, sometimes cracking, sometimes lacunose with lacunae occasionally traversed by hyphal strands; margin arachnoid, thinning. Hyphae scanty to abundant, loosely interwoven, thin-walled to slightly thick-walled, ± perpendicular to the substrate, clamped,sometimes incrusted, often with yellowish contents, with 1-2 branches at a septum, 3-4µm in diam; in thicker fructifications there is often a subhymenial layer of yellowish brown granular material present. Cystidia 63-156 x 10-27µm wide at base, thin- to slightly thick-walled, subulate, or ventricose-cylindrical, arising immediately adjacent to the hymenium, sometimes collapsing. Basidia 14-23 x 5-5.5µm at apex and 7-8µm at base, ventricose-cylindrical to urniform or suburniform, sometimes flexuous; 4 subulate, slightly arcuate sterigmata each ca. 4-6µm long. Spores 6-9 x 4-4.5µm, ellipsoid to suballantoid, 0-2 guttulate.

Specimens examined:Jamaica (949a), Dominica(1845), St. Lucia (1955, 1959).

Illustration: Eriksson, J. and L. Ryvarden, The Corticiaceae of North Europe. Vol. 3. Fungiflora, Oslo, Norway, p. 456, fig. 200. 1975.

3. *Peniophora aspera* (Pers.) Sacc., Fl. Ital.Crypt. Hymen. p. 1182. 1916; *Thelephora aspera* Pers.,Mycol.Eur. 1: 153. 1822. *Vide* Rogs. & Jacks., Farlowia 1:282. 1943.

Thelephora setigera Fr., Elench. Fung. 1:208. 1828; HYPHODERMA SETIGERA (Fr.) Donk, Fungus 27: 15. 1957.

Adnate, pelliculose, up to 150μm thick between denticles, cream to yellowish when dry;surface denticulate, often cracking and exposing the pale fibrous context, sometimes discontinuous, the denticles pilose; margin thinning, whitish, floccose-arachnoid. Basal hyphae ± erect, hyphae branching at wide angles, walls slightly thickened, clamped, 3-4μm in diam. Cystidia projecting up to 65μm; thin-walled, septate with clamps, incrusted with coarse granules, apex rounded or slightly capitate, arising from basidial fasicles and surrounded by basidia. Basidia 12-22 x 3.5-6μm, arising in fasicles, suburniform to urniform; 4 sterigmata each -7μm long. Spores 7.5-11 x 3.5-5 μm, cylindrical, flattened to slightly depressed along one side, guttulate or not.

Specimens examined: Jamaica (406).

Illustration: Eriksson, J. and L. Ryvarden, *l. c.*, p. 528, fig. 246.

4. *Peniophora burtii* Romell in Burt, Ann. Missouri Bot. Gard. 12. 278. 1925 (1926); PHANEROCHAETE BURTII(Romell in Burt) Parm., Izv. Akad. Nauk. Estonsk.SSR. Ser. Biol. 16: 388. 1967.

Pelliculose, separable, 200-300μm thick; surface minutely pruinose, sometimes cracking, yellowish to yellow buff; margin thinning but distinct, irregular,almost white, often with yellow mycelial strands joining different fructifications. Hyphae loosely interwoven, thick-walled, without clamps, frequently branched at ± right angles, 3.5-5.5μm in diam, sometimes incrusted in subhymenium. Cystidia 30-44 x 3.5-5μm, thin- to slightly thick-walled, hyphoid to subclavate. Basidia 19-28 x 4.5-5.5μm, clavate; 4 thin sterigmata each ca. 1-2.5μm long. Spores 3.5-4.5 x 2-2.5μm, oblong-ellipsoid.

Specimens examined: Jamaica (594).

Illustration: Buddington, A.B. and R.L. Gilbertson. Southwest. Nat. 17:418. 1973.

5. *Peniophora byssoides* (Pers. ex Fr.) Bres. apud Brink., Westf. Prov.-Ver. Jahrsb. 26. 130. 1898; *Thelephora byssoides* Pers. ex Fr., Syst. Mycol. 1: 452. 1821; AMPHINEMA BYSSOIDES (Pers. ex Fr.) J. Erikss., Symb. Bot. Upsal. 16: 111. 1958.

Arachnoid, separable, thin; surface very uneven, pruinose, cream brown; margin indistinct, irregular, concolorous. Hyphae scant, thin-walled, clamped, 3.5-4.5µm in diam. Cystidia 50-73 x 4.5-5.5µm, thick-walled, aculeate, clamped at base, sometimes with 1 or more septa, clamped or not. Basidia 11-13.5 x 5.5-6µm, cylindrical-clavate; 4 thin sterigmata each ca. 2-3.5µm long. Spores 4.5-6 x 3-5 µm, globose to subglobose, becoming thick-walled in age.

Specimens examined: Jamaica (742). A very common fungus throughout the region,many other specimens examined.

Illustration: Eriksson, J. and L. Ryvarden. The Corticiaceae of North Europe. Vol. 2, p.80, fig. 29. 1973.

6. PENIOPHORA CARNEA (Berk. & Curt.) Cke., Grevillea 8: 21. 1879; *Corticium carneum* Berk. & Curt., N.Y. Acad. 1: 179. 1898.

Waxy, separable when moistened, 130-220µm thick, surface pruinose, buff to light gray, large embedded crystalline material visible from above; margin pruinose, thinning, indistinct, white. Hyphae agglutinated, darkly pigmented, running parallel to substrate and giving rise to light colored, less agglutinated, thin-walled hyphae 2-5µm in diam which form the hymenium; large crystalline masses about 110 x 66µm in extent, not associated with cystidia, embedded in context beyond the basal agglutinated layer. Cystidia 30-44 x 8.5-10µm, thick-walled, clavate, incrusted and embedded; other thin-walled cystidia 56-116 x 7.5-10.5 µm present, flexuous, and often protruding beyond the hymenium. Basidia not seen. Spores 5.5-14.5 x 3.5-4.5 µm, subglobose to ellipsoid.

Specimens examined: Cuba (Earle & Murrill 333 in NY); Texas (H.W. Ravenel 78 TYPE in K).

7. PENIOPHORA CINEREA (Fr.) Cke., Grevillea 8: 21. 1879; *Corticium cinereum* Fr., Elench. Fung. 1: 221. 1828.

Thin, adnate,waxy, at first in small round patches, then confluent, gray buff or pink to bluish gray or pure gray, 50-100µm thick; surface finely pruinose; margin thin, concolorous or paler. Hyphae compact, difficult to distinguish individually, stratose in some specimens, usually with a narrow basal horizontal zone adjacent to substrate. Cystidia 20-40 x 6-12µm, distributed throughout the context, arising at all levels, embedded or projecting up to 15µm, conical or fusiform, attenuated; young, thin-walled cystidia slightly or not at all incrusted; others thick-walled and heavily incrusted with coarse crystals. Basidia 12-20 x 4-6µm, clavate; 4 sterigmata each ca. 4µm long. Spores 7-9 x 3-3.5µm, allantoid.

Specimens examined: Grenada (1409, 1468), Dominica (1834), St. Lucia (2013), St. Vincent (2046), Jamaica(680).

8. SUBULICYSTIDIUM COCHLEUM A. Punugu, *sp. nov.* Fig. 1.

Differt haec species a Subulicystidio longisporo (Pat.) Parm. cystidis acicularibus obtectis in partibus subterminalibus et sporis cochleatis.

Arachnoid-floccose, easily detached, hispidulose, bluish white, thin, ca. 35µm thick; margin indefinite. Hyphae scanty ± horizontal, thin-walled, hyaline, sometimes suberect and branched at ± right angles, rough walled because of incrustations, clamped, 2.5-3.5µm in diam. Cystidia 60-80µm long, acicular, projecting beyond the hymenium, erect or bent toward the middle, walls slightly thickened basally, sometimes slightly inflated and often ensheathed by large smooth crystals; enclosed in long acicular crystals above the middle, the crystals arranged in a cone-like fashion; the terminal exposed portion thin-walled, smooth, slender, and occasionally with granular contents. Basidioles subglobose, often surrounded by a thin crystalline sheath. Basidia 12.5-17 x 5-6µm, developing by elongation through the often persisting crystalline sheath, sometimes stipitate; 4 subulate, arcuate sterigmata, each ca. 5µm long. Spores 20-27 x 2-3µm, long, slender, the distal end folded back or twisted and curved, in which case the length is 12-17µm.

Specimens examined: St. Lucia (1363 TYPE in NO, 2037), St. Vincent (2059).

9. *Peniophora cremea* (Bres.) Sacc. & Syd., Syll. Fung. 16: 195. 1902; *Corticium cremea* Bres., Fung. Trid. II. 63. 1898; PHANEROCHAETE CREMEA (Bres.) Parm., Consp. Cort. 84. 1968.

Submembranous, ± separable, up to 450µm thick; surface pale cream, yellow to brownish buff, velutinous, often cracking and exposing pale or white context; smooth to sometimes grandinioid, margin wide, thinning to almost arachnoid. Hyphae loosely interwoven, ± erect, thick-walled, often incrusted, hyaline, branching at ± right angles, without clamps, 4-7µm in diam. Hymenium stratose in older specimens and of thin-walled, sometimes yellowish hyphae 2-

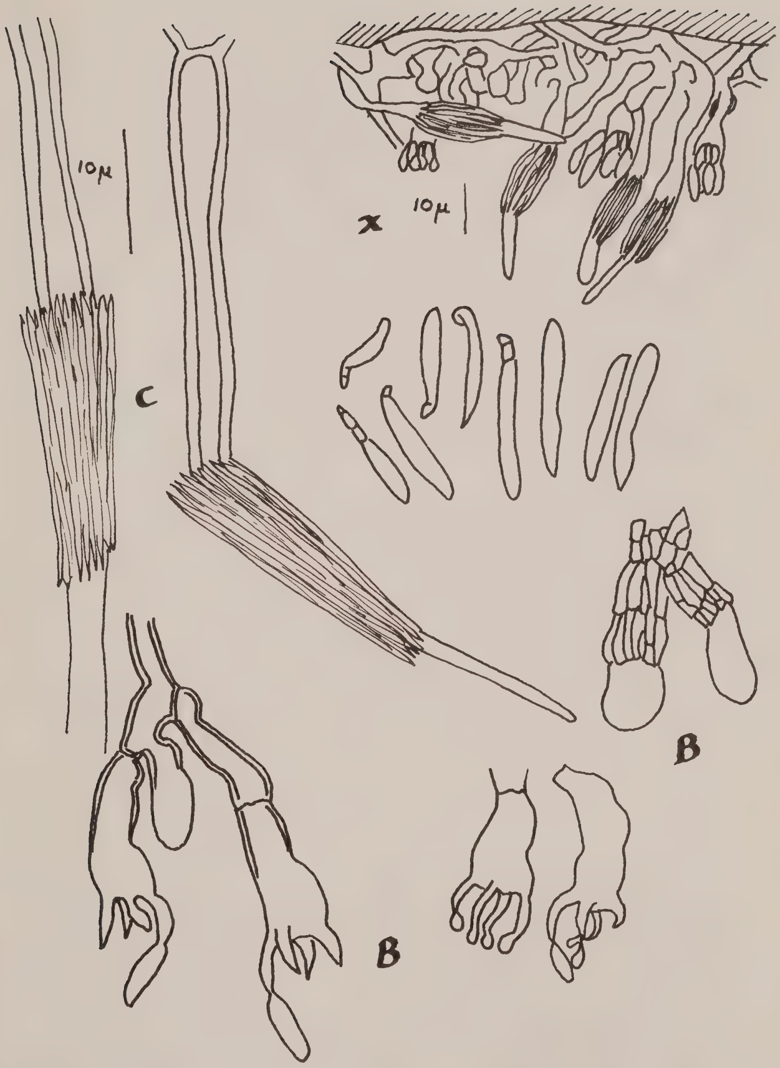

Fig. 1. *Subulicystidium cochleum* A. Punugu. X. Semi-schematic drawing of a section of the basidiocarp showing the thin-walled repent hyphae, cystidia, and basidia. C. Cystidia with acicular crystals. B. Basidial development; basidioles with persistent crystalline sheath and basidia showing thick walls in the basal portion exposed after the dissolution of the incrustation in dilute KOH.

3µm in diam. Cystidia 30-90 x 6-12µm, often projecting up to 35µm beyond the hymenium, thin- to thick-walled with almost solid apices, cylindrical, fusiform to subulate, sometimes with a narrow stipe, not at all to heavily incrusted at the usually obtuse apex, embedded throughout the hymenial strata. Basidia 10-15 x 4-6µm, clavate, subclavate, or sometimes urniform, often projecting in fasicles and giving the surface an undulating appearance; 4 slender sterigmata, each ca. 4µm long. Spores 4-6 x 2-3µm, ellipsoidal to cylindrical, flattened along one side.

Specimens examined: Jamaica (759, 626).

Illustration: Gilbertson, R.L., *l.c.*, p. 50,fig. 52.

10. *Peniophora dussii* (Pat.) Hoehn. & Lits.,Sitsungeber. K. Akad. Wiss. Wien Math.--Nat. Kl. 116: 749. 1907; *Hypochnus dussii* Pat., Bull. Soc. Myc. France 15: 202. 1899; XENASMA DUSSII (Pat.) Liberta, Mycologia 52: 898. 1960.

Thin, 10-20µm thick, white or bluish, forming a film over the substrate, pruinose and hispid, easily separable. Hyphae 2-2.5µm in diam, ± parallel to the substrate, with clamps, walls fused or gelatinized. Cystidia 55-100 x 8-15µm, conical, erect, with several "roots", with thick lamellate walls ensheathed by delicate hyphae -1µm in diam. Basidia 12-29 x 5-7µm, cylindrical to subclavate, with bifurcate base, or borne terminally with a basal clamp, with 4 arcuate sterigmata each ca. 4.5-5µm long. Spores 7-14 x 2.5-3.5µm, smooth, lunate to falcate.

Specimens examined: Dominica (2774).

Illustration: Liberta, A.E.,*l.c.*, p. 896, fig. 9.

11. *Peniophora filamentosa* (Berk. & Curt.) Burt apud Coker, J. Elisha Mitchell Sci. Soc. 36 : 162. 1921; *Corticium filamentosum* Berk. & Curt., Grevillea 1: 178. 1873; PHANEROCHAETE FILAMENTOSA (Berk. & Curt.) Parm., Consp. Syst. Cort. 83. 1968. Fig. 2.

Membranous, pellicose, soft or firm, easily separable, 300-350µm thick; surface rusty brown,finely pruinose, sometimes cracking and exposing the darker context; margin thinning, often with mycelial strands. Hyphae loosely interwoven, hyaline, thick-walled, ± erect, branching at ± right angles, with thinner walls and narrower diam toward the hymenium, without clamps, sometimes incrusted in the subhymenial region, 3-6µm in diam, with crystals in the context and subhymenium. Cystidia 55-80µm long, projecting

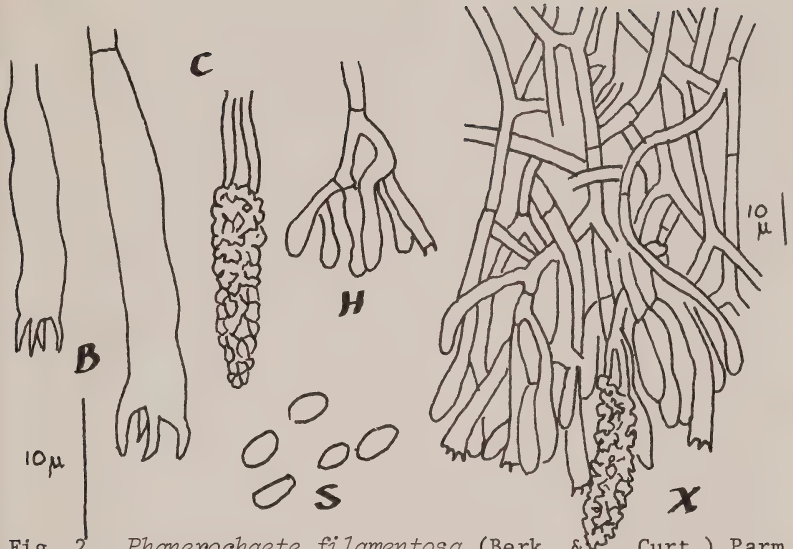

Fig. 2. *Phanerochaete filamentosa* (Berk. & Curt.) Parm. x. semi-schematic drawing of a section through the basidiocarp. B. Basidia. S. Spores. H. Fasicle of basidioles. C. Cystidium.

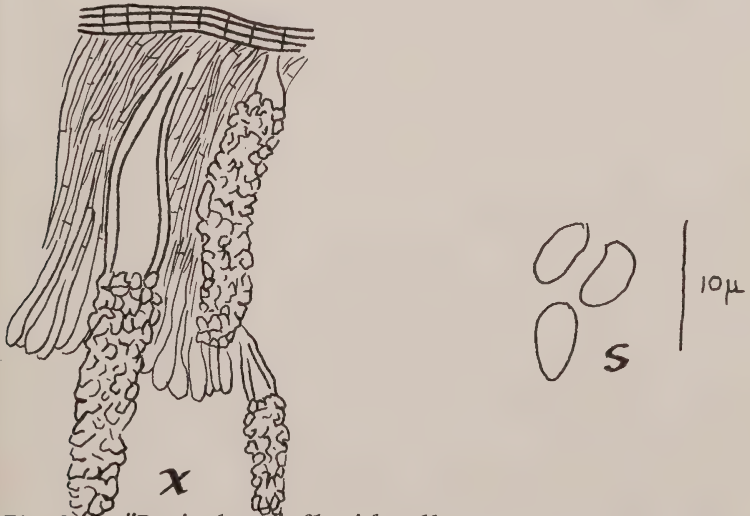

Fig. 3. "*Peniophora*" *flavido-alba* Cke. X. Semi-schematic drawing of a section of the basidiocarp showing the waxy context and large incrusted cystidia. C. Cystidia. S. Spores.

-10µm beyond the hymenium, long-cylindrical, with obtuse apices, upper 1/2 or 2/3 completely incrusted with large hyaline crystals that slowly dissolve in KOH, occasionally 2-3 septate. Basidia 18-28 x 5-6µm, flexuous, walls thickened toward base; 4 subulate sterigmata each ca. 3-7µm long. Spores 4-5 x 2-4µm, subglobose or short-cylindrical, flattened on one side, guttulate.

Specimens examined: Jamaica (1488), Trinidad(1593, 1727, 1777).

12. *"Peniophora" flava* (Burt) Rog. & Jacks., Farlowia 1: 278. 1943; *Coniophora flava* Burt, Ann. Missouri Bot. Gard. 4: 261. 1917.

Dry, separable, ca. 225µm thick; surface pruinose and inconspicuously warted, tan to buff yellow. Hyphae thick-walled, mostly parallel to the substrate, some in denser strands, giving rise to a compact hymenium, clamped, infrequently branched and then at ± right angles, branches erect, thin-walled and narrow, incrusted, 3-5.5µm in diam. Cystidia 44-60 x 6.5-7µm,cylindrical-clavate to ventricose, incrusted, walls slightly thickened. Basidia 22-25 x 4-5 µm, clavate; 4 sterigmata each ca. 3.5µm long. Spores 4-6 x 3-3.5µm ($\bar{x}$ 10 = 4.8 x 3.2µm).

Specimens examined: Jamaica (W.A. & E.L. Murrill 1089 TYPE in NY and ISOTYPE in FH).

13. *"Peniophora" flavido-alba* Cke., Grevillea 8:21. 1879. Fig. 3.

Adnate, waxy, thin, pinkish buff to tan, ca. 700µm thick; surface hispid, cracking and exposing the paler context; margin thinning, indeterminate, often paler in color. Basal hyphae -5µm in diam, horizontal, with slightly thickened walls, giving rise to a densely interwoven intermediate layer and a compact hymenium of thin-walled hyphae without clamps, not incrusted, 2.5-3µm in diam. Cystidia 70-120 x 15-25µm, thick-walled, incrusted, tapering at the apex, arising from the wide basal hyphae, tilted at an angle or straight, projecting -50µm, or embedded. Basidia 15-20 x 5-7.5µm, clavate, sometimes stipitate, slightly projecting; 4 sterigmata each ca. 3-5µm long. Spores 5-6.5 x 2.5-4µm, slightly flattened on one side, or curved.

Specimens examined: Jamaica (457), Trinidad (W.L. White 80 in FH).

14. *Peniophora gracillima* Ell. & Everh. ex Rogs. & Jacks., Farlowia 1: 317. 1943; TUBULICRINIS GRACILLIMA (Ell. & Everh. ex Rogs. & Jacks.) Donk, Fungus 26: 13. 1956. Fig. 4.

Adnate, thin, waxy, soft,-85μm thick; surface yellowish buff, even, hispid; margin thinning, indeterminate, arachnoid. Basal hyphae 2-3μm in diam, horizontal, thick-walled, giving rise to cystidia and erect, tightly compact hyphae ending in basidia. Cystidia 75-110 x 7-10μm, projecting -60μm beyond the hymenium, long-cylindrical with birooted bases, with a narrow lumen that often abruptly dilates into a bulbous apex, abruptly soluble in ammoniacal Congo Red (lyocystidia), slightly amyloid, neck and bulbous apex often incrusted. Basidia 15-25 x 4-5μm, flexuous. Spores 6-8 x 1.5-2μm.

Specimens examined: Grenada (1368).

15. *Peniophora hiulca* Burt, Ann. Missouri Bot. Gard. 12: 272. 1925 (1926); PHANEROCAETE HIULCA (Burt) Welden, *comb. nov.*

Pelliculose, separable, 500-1000μm thick; surface smooth, tan to ochraceous, cracked; margin pruinose, thinning, distinct, light tan. Hyphae 3-7μm in diam, in a dense basal layer parallel to the substrate, thick-walled, giving rise to erect, densely interwoven hyphae branching at ± right angles, some incrusted, clamped. Cystidia 30-52 x 5.5-9μm, thick-walled, lanceolate to clavate, incrusted. Basidia 17-30 x 4.5-5.5μm, clavate; 4 sterigmata. Spores 4.5-8 x 3.5-4μm.

Specimens examined: Jamaica (W.A. & E.L. Murrill 71 TYPE in NY, ISOTYPE in FH).

Illustration: Liberta, A.E.,*l.c.*, p. 847. fig. 7.

The spore measurements given here are larger than those reported by either Burt or Liberta. The spores were not abundant and may not belong to the specimens examined.

16. *"Peniophora" inflata* Burt, Ann. Missouri Bot. Gard. 12: 267. 1925 (1926), *vide* Liberta, Mycologia 60: 855. 54. 1968.

Waxy, membranous, separable, 125-350μm thick; surface smooth to inconspicuously warted, pale yellow, cracking and peeling from the substrate; margin pruinose to arachnoid, thinning, indeterminate, white. Hyphae loosely

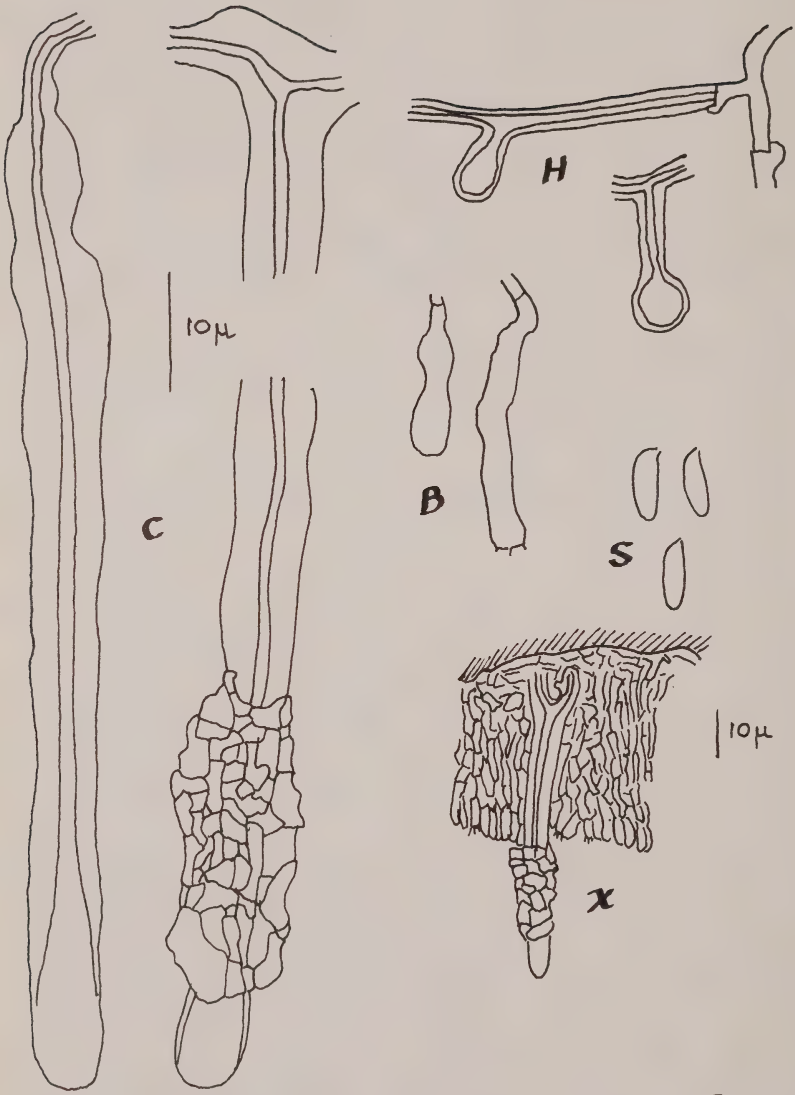

Fig. 4. *Tubulicrinis gracillima* (Ellis & Everh. ex Rogs & Jacks.) Donk. X. Semi-schematic drawing of a section of the basidiocarp showing waxy context and incrusted lyocystidia. H. Young cystidia developing from thin-walled hyphae. C. Mature lyocystidia with and without incrustation. B. Flexuous basidiole and basidium. S. Spores.

interwoven, thin-walled, clamped, hyaline, 1.5-4.5µm in diam, lateral branches 12-25 x 2-3.5µm, with terminal and median inflations often incrusted with ± parallel crystals; hymenium a thick layer of sometimes pseudoparenchymatous clamped hyphae. Cystidia 27-43 x 4.5-5.5µm, thick-walled, cylindrical, often slightly pointed at apex, incrusted, originating throughout the hymenium. Basidia 11-14 x 3-4µm, clavate; 4 sterigmata needle-like and each ca. 2-3µm long. Spores 3.5-4.5 x 1.5-3µm.

Specimens examined: Jamaica (W.A. & E.L. Murrill 4 TYPE in NY, ISOTYPE in FH).

Illustration: Liberta, A.E., *l.c.*, p. 853. fig.28.

17. *Peniophora longispora* (Pat.) Hoehn., Ann. Mycol. 3:235. 1905; *Hypochnus longisporus* Pat., J. Bot. 8:221. 1894; SUBULICYSTIDIUM LONGISPORUM (Pat.) Parm., Consp. Syst. Cort. 121. 1968. Fig. 5.

Thin, arachnoid-floccose to membranous, 30-100µm thick, white then bluish gray or yellowish; surface pubescent to pilose, often discontinuous; margin thinning, arachnoid, concolorous. Hyphae interwoven, a few horizontal at the base, the remainder erect, thin-walled, clamped, hyaline, branching ± at right angles without any relation to septa, often rough-walled, 2-3µm in diam. Cystidia 37-83 x 2-6µm, acicular, emergent -45µm beyond hymenium, base slightly flattened and often clamped, walls 1-1.5µm thick, incrusted with small orthorhomboidal crystals distributed in ± longitudinal rows, lumen narrow, apex pointed, oblique, or bifurcate. Basidia 9-13 x 4-6µm, suburniform, sometimes stipitate, frequently clamped at base; with 4 subulate, arcuate sterigmata, each 3-4µm long. Spores 8-15 x 2-3µm, cylindrical to suballantoid, guttulate.

Specimens examined: Jamaica (598, 757, 905, 949), Dominica (1906, 1925).

18. *"Peniophora" ludoviciana* Burt, Ann. Missouri Bot. Gard. 12: 224. 1925 (1926).

Peniophora flammea Burt, Ann. Missouri Bot. Gard. 12: 252. 1925. (*teste* Rogs. & Jacks.,Farlowia 1:316. 1943).

Waxy, separable when moistened, 90-200µm thick, yellow buff to orange, often turns red with KOH solution; surface minutely hispid to pruinose, uneven but generally not cracked; margin thinning but distinct, irregular, white. Context white and hymenium yellow, of agglutin-

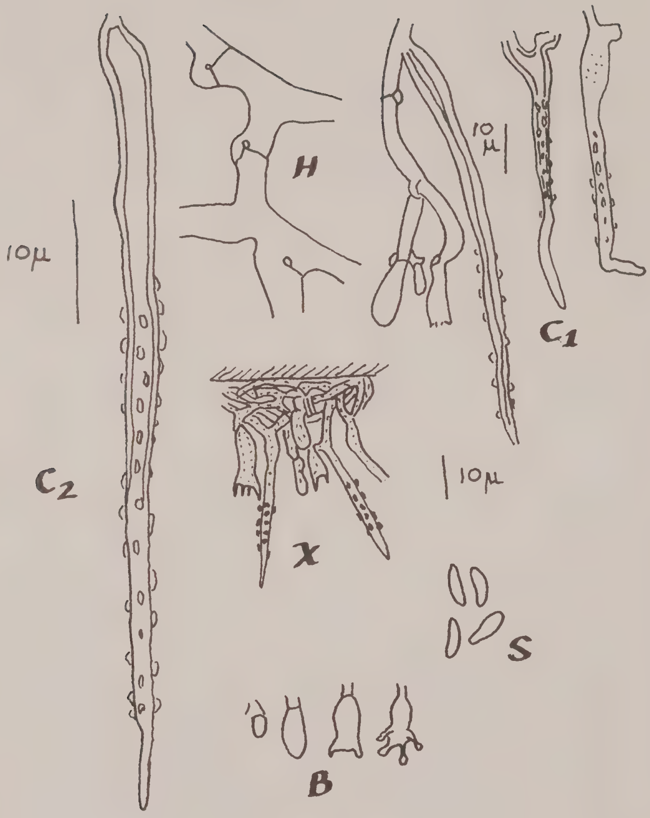

Fig. 5. *Subulicystidium longisporum* (Pat.) Parm. X. Semi-schematic drawing of a section through the basidiocarp showing repent hyphae, acicular cystidia, and basidia. C. Cystidia. B. Basidial development. S. Spores.

ated thin- to slightly thick-walled clamped, incrusted, hyphae, 2-3µm in diam; hymenium heavily incrusted, with some incrustations brown and dissolving in KOH and producing a red color. Cystidia 45-60 x 5.5-13.5µm, thin-walled, heavily incrusted and obclavate, or unincrusted and hyphoid. Basidia 20-22 x 4.5µm, clavate; 4 slender sterigmata each ca. 1.5-3µm long. Spores 4.5-6 x 2-3µm.

Specimens examined: St. Lucia (1898); Jamaica (597, 776); Louisiana (A.B. Langlois 1919, TYPE in FH).

19. *Peniophora phosphorescens* Burt, Ann. Missouri Bot. Gard. 12: 273. 1925 (1926); PHANEROCHAETE PHOSPHORESCENS (Burt) Welden, *comb. nov.*

Waxy, separable, 350-600µm thick; surface pruinose with some warts, dark brownish red to brownish orange; margin waxy, fimbriate, thinning, distinct, pale orange. Basal hyphae 2-7µm in diam, loosely interwoven, thick-walled, branching at ± right angles, without clamps; hymenium subtended by a layer of compact ± parallel hyphae, of agglutinated, thin-walled hyphae without clamps and variously branched, 2-3µm in diam. Cystidia 74-151 x 12-20µm, thick-walled, obclavate to cylindrical, incrusted, embedded in the lower reaches of the hymenium. Basidia 20-28 x 5.5-6µm, cylindrical to clavate, sometimes constricted in the middle; 4 slender sterigmata each ca. 3.5-5µm long. Spores 4.5-5.5 x 3.5-4.5µm.

Specimens examined: Jamaica (A.E. Wright 1909 TYPE in FH).

Illustration: Liberta, A.E., *l.c.*, p.848, fig. 21.

20. *Peniophora piliseta* Burt, Ann. Missouri Bot. Gard. 12: 242. 1925 (1926); HYPHODERMA PILISETA (Burt) Liberta, Mycologia 60: 835. 1968.

Thin, membranous, 100-120µm thick, ± separable; surface cream colored, finely pruinose, cracking slightly; margin thinning, arachnoid. Basal hyphae ± parallel to substrate, clamped, ca. 3µm in diam; intermediate hyphae thin-walled, loosely arranged, clamped, 2-3µm in diam. Cystidia 20-31 x 7.5-11µm, arising within context, incrusted, ± cylindrical, obtuse. Basidia 20-25 x 5-8µm, stipitate; 4 slender sterigmata each ca. 2µm long. Spores 9-12 x 4-5µm, flattened or slightly curved on one side, 1-2 guttulate.

Specimens examined: Jamaica(TYPE in Missouri Bot. Gard. Herb. 63243 in BPI).

Illustration: Liberta, A.E., *l.c.*, p. 836, fig.8.

21. *"Peniophora" ravenelii* Cke., Grevillea 8:21.1879.Fig.6.

Adnate,separable,waxy,300µm thick; surface finely pruinose or smooth, pinkish buff, cracking slightly; margin thinning, membranous. Basal hyphae erect, compact, pseudoparenchymatous, ca. 3µm in diam. Cystidia 30-45 x 12-20µm, abundant,distributed in close tiers throughout the basidiocarp, conical, broad at base, heavily incrusted with coarse granules, those of hymenium up to 15µm in diam. Basidia ca. 15 x 5µm, subclavate with a slight median constriction; 4 slender sterigmata each ca. 4.5µm long. Spores 4-5 x 2-3µm.

Specimens examined: Jamaica (600); South Carolina (Fungi Car. Exs. 2: 39 TYPE in BPI).

22. *"Peniophora" roumeguerii* (Bres.) Burt, Ann. Missouri Bot. Gard. 12: 270. 1925 (1926); *Corticium roumeguerii* Bres. Fungi Trid. 2: 36, 1892. Fig. 7.

Adnate, waxy, separable, 750µm thick; surface pruinose to hispid, sometimes grandinioid, often cracking and exposing the subiculum in the fissures, white, grayish buff, cream buff, yellow, or pinkish buff; margin thinning, indefinite, concolorous, sometimes paler. Hyphae thin-walled, agglutinated, ± pseudoparenchymatous, ± erect except in basal horizontal layer which is not always present, 2-3µm in diam. Cystidia 40-85 x 8-20µm, abundant, scattered in every strata and tier except zone adjacent to substrate, heavily incrusted, conical, tapering to acute apices, protruding ones long; hymenium zonate in some specimens. Basidia 15-25 x 3-5.5µm, cylindrical or with slight median constriction, or subulate. Spores 5-6 x 3-4µm, flattened on one side.

Specimens examined:Jamaica(546, 630, 1027, 1267); Grenada (1401).

23. *"Peniophora" sacchari* Burt, Ann. Missouri Bot. Gard. 12: 328. 1925 (1926). Fig. 8.

Membranous, thin, adnate, 20-140µm thick; surface brownish yellow with a darker center, cracking into small irregular areas showing a concolorous subiculum, smooth or finely pruinose; margin arachnoid, thinning, sometimes this thin zone quite extensive, discontinuous or lacunose,

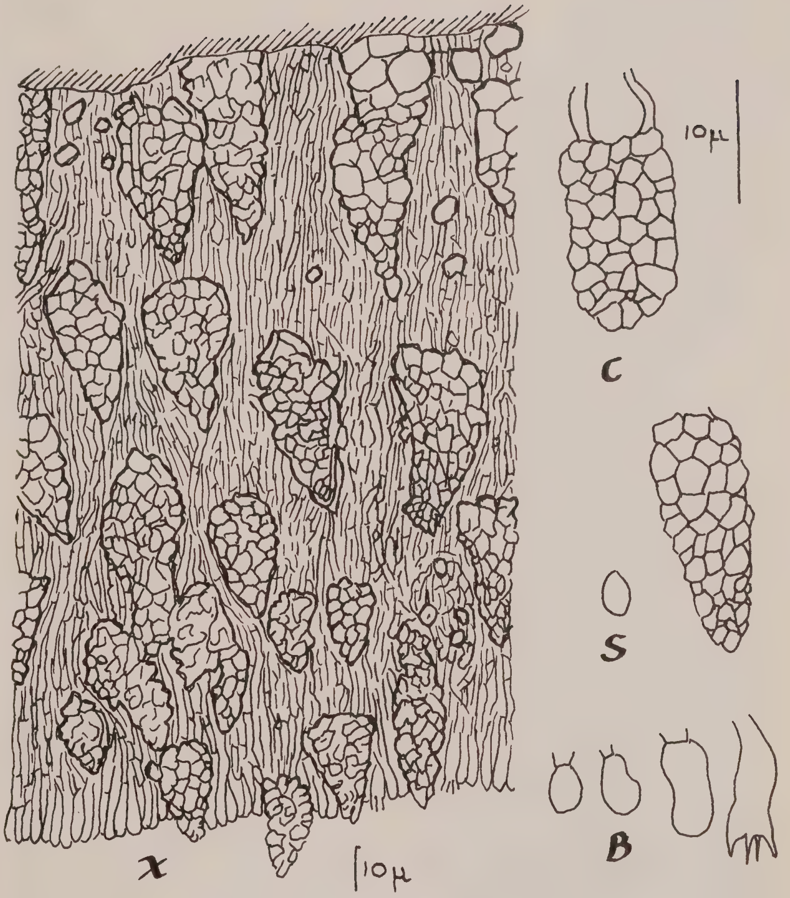

Fig. 6. *"Peniophora" ravenelli* Cke. X. Semi-schematic drawing of a section through the basidiocarp showing the waxy content and numerous cystidia. C. Incrusted cystidia. B. Basidial development. S. Spore.

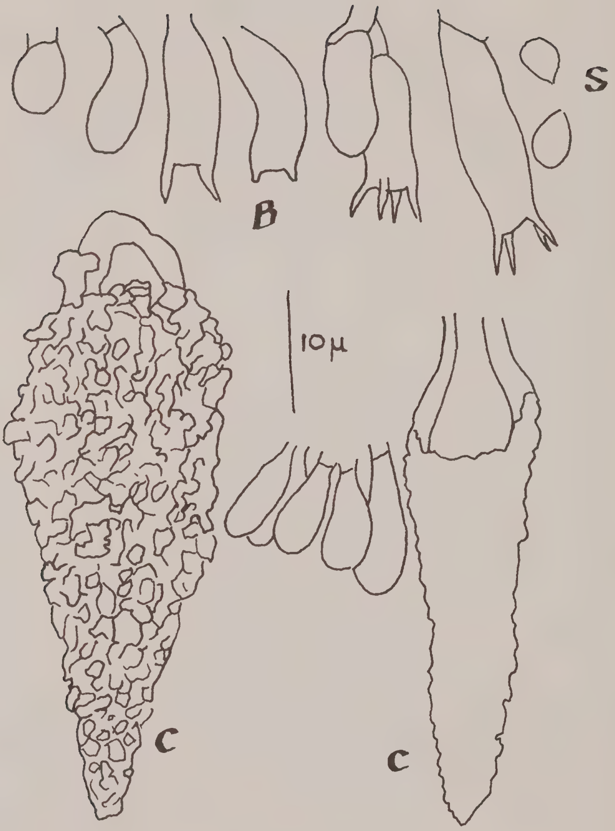

Fig. 7. *"Peniophora" roumeguerii* (Bres.) Burt. C. Cystidia. B. Basidial development. S. Spores.

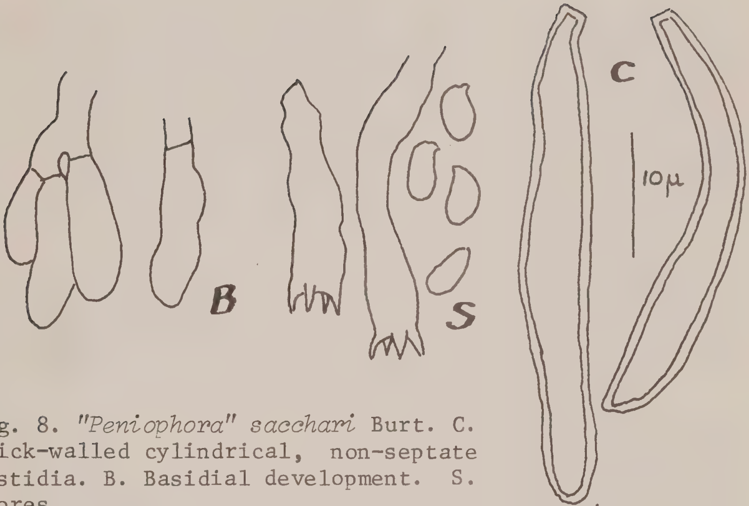

Fig. 8. *"Peniophora" sacchari* Burt. C. Thick-walled cylindrical, non-septate cystidia. B. Basidial development. S. Spores.

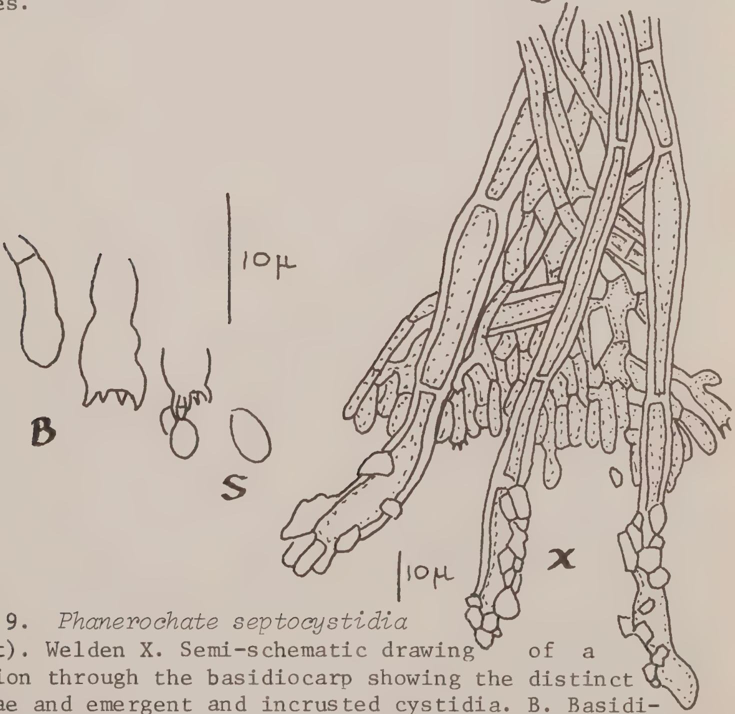

Fig. 9. *Phanerochate septocystidia* (Burt). Welden X. Semi-schematic drawing of a section through the basidiocarp showing the distinct hyphae and emergent and incrusted cystidia. B. Basidiole and basidia with spores. S. Spores.

cream colored. Basal hyphae horizontal with ± erect, loosely arranged, thin- or slightly thick-walled, occasionally clamped, 3-4µm in diam. Cystidia 35-60 x 11µm, not incrusted, slightly thick-walled, ± cylindrical, tapering to a pointed or obtuse apex, projecting -15µm beyond hymenium. Spores 6-8 x 3-4µm, slightly depressed on one side, a few embedded in the context.

Specimens examined: Puerto Rico, (TYPE Missouri Bot. Gard. Herb. 11787 in BPI).

24. *Peniophora sambuci* (Pers. ex Fr.) Burt, Ann. Missouri Bot. Gard. 12: 233. 1925 (1926);*Corticium sambuci* Pers. ex Fr., Epicr.565.1838;ROGERSELLA SAMBUCI (Pers.ex Fr.) Liberta, Can. J. Bot. 56: 1781. 1978.

Adnate, thin, -300µm thick; surface continuous, white to cream color, pruinose, grandinioid; margin thinning. Hyphae ± erect, somewhat loosely interwoven, thin-walled, often with 3 branches at a septum, clamped, incrusted, 2.5-3.5µm in diam. Cystidia 28-45 x 3-5µm, fusiform or subulate, tapering or capitate, smooth or incrusted with fine granules, projecting -35µm beyond the hymenium.Basidia 15-26 x 5-5.5µm, suburniform; 4 slender sterigmata. Spores 5-6 x 3-4µm.

Specimens examined: Dominica (1908).

25. *Peniophora septocystidia* Burt, Ann. Missouri Bot. Gard. 12: 260. 1925 (1926);PHANEROCHAETE SEPTOCYSTIDIA (Burt) J. Erikss. & Ryv., The Corticiaceae of North Europe. Vol. 3, p. 1021. 1978. Fig.9.

Membranous, separable, 400µm thick; surface sometimes discontinuous and widely cracking into small irregular areas exposing the floccose subiculum, sulfur yellow with reddish brown tints because of pigmented cystidial incrustrations, slightly hispid; margin thinning, floccose with distinct hyphal threads. Basal hyphae thick-walled, coarse, distinct, without clamps, incrusted with short flattened crystals; upper hyphae compact, thin-walled, erect, difficult to distinguish individually, often 3 branches at a septum. Cystidia 60-130 x 9-11µm, septate,incrusted with large pigmented granules,arising as thick-walled hyphae and projecting -40µm beyond the hymenium; 4 slender sterigmata each 4-5µm long. Spores 4.5-7 x 2-3µm, allantoid.

Specimens examined: Jamaica (TYPE Missouri Bot. Gard. Herb. 61492 in BPI).

26. *"Peniophora" similis* (Berk. & Curt.) Massee, J. Linn. Soc. Bot. 25: 147.1889; *Corticium simile* Berk. & Curt., J. Linn. Soc. Bot. 10: 337. 1868.

Membranous, separable, 1000µm thick; surface pruinose to smooth in thicker specimens, dirty white to pale tan; margin arachnoid to pruinose, thinning, indistinct, off-white. Basal hyphae densely interwoven, ± parallel to substrate, turning erect and forming a large zone beneath the hymenium, rarely clamped, some thick-walled, 2-4.5µm in diam; subhymenium ± pseudoparenchymatous and sometimes incrusted. Cystidia 20-44 x 5.5-8µm, somewhat clavate, arising from thick-walled hyphae, incrusted. Basidia 17.5-21 x 4-5 µm; 4 stout sterigmata each ca. 5 x 1.5µm. Spores 3-4.5 x 2-3µm.

Specimens examined: Cuba (C. Wright 543 ISOTYPE in FH, Earle & Murrill 42, 303 in NY).

27. *Peniophora subalutacea* (Karst.) Hoehn. & Lits., Sitzungsber.Kaiserl. Acad. Wiss., Math.-Naturwiss. Cl.,Abt.1. 115:1601.1906;*Corticium subalutaceum* Karst., Meddeland. Soc. Fauna Fl. Fenn.9: 65.1883; HYPHODONTIA SUBALUTACEA (Karst.) J. Erikss., Symb. Bot. Upsal. 16: 104. 1958.

Thin, pelliculose, 150µm thick; surface straw-buff to yellowish buff, sometimes discontinuous; margin indefinite, thinning, arachnoid-floccose. Hyphae unincrusted, with slightly thickened walls, coarse, branched at wide angles, clamped at most septa, profusely branched in upper parts and often with 3 branches at a septum, 2-4µm in diam. Cystidia 70-120 x 5-8µm neither incrusted nor septate, thick-walled and tubular with the lumen widening toward obtuse apex, originating from basal hyphae and projecting -40 µm beyond the hymenium. Basidia 12-20 x 4.5-5.5µm, with a slight median constriction; 4 slender sterigmata. Spores 7-9 x 1.5-2µm, allantoid.

Specimens examined: Jamaica (981).

Illustration: Eriksson, J. and L. Ryvarden, The Corticiaceae of North Europe. Fungiflora, Oslo, Norway, Vol. 4. p. 674, Fig. 330. 1976.

28. *Peniophora tenuis* (Pat.) Massee, J. Linn. Soc. Bot.25: 149. 1889. *Corticium tenue* Pat., Rev.Mycol.(Paris)7: 152. 1885; HYPHODERMA TENUIS (Pat.) Donk, Fungus 27: 15. 1957.

Adnate, separable when moist, 50-120µm thick;surface smooth to pruinose, buff-tan to buff-white; margin pruinose, thinning, indistinct, pale tan. Hyphae loosely arranged, thick-walled, clamped, branching variously, 2-5µm in diam. Cystidia 71-115 x 13µm, thin- to slightly thick-walled, obclavate to fusiform. Stephanocysts 9 x 10µm, globose. Basidia 20-33 x 7-8µm, clavate with narrow base, subtended by a clamp; 4 slender sterigmata each ca. 3-3.5µm long. Spores 8-10 x 4.5-5µm, guttulate.

Specimens examined: Jamaica (Murrill & Harris 1053 in FH). For a discussion of this taxon see Rogers & Jackson, Farlowia 1: 322. 1943 and J. Eriksson and L. Ryvarden, The Corticiaceae of North Europe 3: 505. 1975, as *H. praetermissum* (Karst.) J. Erikss. & Strid.

29. PENIOPHORA VERSICOLOR (Bres.) Sacc. & Syd. apud Sacc., Syll. Fung. 16: 193. 1902; *Corticium versicolor* Bres., Fungi Trid. 2: 61. 1892.

Adnate, waxy, 60-100µm thick;surface finely pruinose, near rose gray, slightly cracking; margin thinning, paler in color, or rusty. Hyphae ± erect, loosely interwoven, thick-walled, pigmented, giving rise to cystidia and to thin-walled hyphae which bear the basidia, 4 - 5µm in diam. Cystidia 30-50 x 8-12µm, stipitate, embedded or projecting -15µm beyond the hymenium, the portion below the incrustation with yellow or brown walls. Basidia 20 - 25 x 4-4.5µm, clavate or subclavate, arising from thin-walled hyphae; 4 slender sterigmata, each ca. 5µm long. Spores 9 x 3.5-4µm, slightly flattened on one side.

Specimens examined: Jamaica (499).

The only specimen studied fits well with the description and drawings given by Eriksson, Sym. Bot. Ups.10: 176. 1950.

30. PENIOPHORA VERSIFORMIS (Berk. & Curt.) Bourd. & Galz., Hym. de France 327. 1928; *Stereum versiforme* Berk. & Curt., Grevillea 1: 164. 1873.

Effused to effuso-reflexed, easily separable, or adnate, at first orbicular then spreading and becoming confluent, ca. 200-300µm thick; surface velutinous, zonate, Natal Brown, sometimes cracking, the curved hymenial surface often blackish; margin indefinite. Hyphae thick-walled, clamped, brown, ± horizontal next to substrate then rising obliquely toward hymenium; intermediate zone ± loosely arranged and intermingled with thin-walled hyphae

3-3.5μm in diam which give rise to basidia. Dendrophyses 1.5-2μm in diam, numerous, yellow brown, their bushy tips emergent beyond hymenium. Cystidia 35-70 x 18-25μm heavily incrusted, embedded or projecting beyond hymenium, confined to a single layer and mixed with basidia and dendrophyses. Basidia ca. 20 x 5μm; 4 slender sterigmata. Spores 6-8 x 2.5-3μm, allantoid.

Specimens examined: Jamaica (Powell 830 in NO).

DOUBTFUL RECORDS

1. *Peniophora citrinella* (Berk. & Curt.) Burt, Ann. Missouri Bot. Gard. 12: 327. 1925 (1926); *Corticium citrinellum* Berk. & Curt., J. Linn. Soc. Bot. 10:336. 1868.

The TYPE from Cuba (C. Wright 844 in Curtis Herb. in FH) and a Jamaican collection (Earle & Murrill 427 in FH & NY) are sterile. Other known Cuban material (Earle & Murrill 381 in FH and 427 in FH & NY) is also sterile. White's material from Cuba (W.L. White 880 in FH) is fertile.It is membranous, ca. 100μm thick, light clay colored, with a fibrillose rhizomorphic margin. The cystidia are 23-25 x 5-6μm and resemble the basidioles. The basidia are 25-32 x 4.5-6μm, subclavate and have 4 thin sterigmata, each ca. 3-4.5μm long. The non-amyloid, smooth, ellipsoid spores are 4.5-5.5 x 2-3μm.

2. *Peniophora galachroa* Bres., Hedwigia 35: 200. 1896.

The TYPE from Brazil (A. Möller in FH) is sterile. None of the West Indian material resembles the type. The Murrills' collections (Murrill & Murrill 33, 721 in NY) from Jamaica are the same taxon and differ from the Puerto Rican material (Stevenson 2985 in BPI). Only one of these is peniophoroid.

3. *Peniophora inconspicua* (Berk. & Curt.) Massee, J. Linn. Soc. Bot. 25: 149. 1889; *Corticium inconspicuum* Berk & Curt., J. Linn. Soc. Bot. 10: 336. 1868.

The ISOTYPE from Cuba (C. Wright 841 in FH) is sterile and constitues the only report of this taxon from the West Indies.

4. *Peniophora mutata* (Peck) Bourd. & Galz., Bull. Soc. Mycol. France 28:399. 1913; *Corticium mutatum* Peck.,N.Y. State Mus. Rep. 43: 67, 1890;HYPHODONTIA MUTATUM (Peck) Donk, Fungus 27: 15. 1957.

The material upon which the West Indian report is based (Grenada: W.G. Farlow 4 in FH) is sterile.

5. *Peniophora pruinata* (Berk. & Curt.) Burt, Ann. Missouri Bot. Gard. 12: 340. 1925 (1926);*Stereum pruinatum* Berk. & Curt., J. Linn. Soc. Bot. 10: 332. 1868.

All of the West Indian material (Cuba: C. Wright 193 ISOTYPE in FH, W.L. White 601 in FH, and Earle & Murrill 516 in NY) is sterile.

6. *Peniophora seymouriana* Burt, Ann. Missouri Bot. Gard. 12: 337. 1925 (1926).

The Cuban material (Missouri Bot. Gard. Herb. 554-95 in BPI, PARATYPE) lacks spores. According to Liberta (Mycologia 60: 842. 1968) holotypic and paratypic material are of two different taxa; the former probably a member of *P. cinerea* group, the latter *P. versiformis* group.

7. *Peniophora tephra* (Berk. & Curt.) Cke., Grevillea 8:20. 1879; *Corticium tephrum* Berk. & Curt., J. Linn.Soc. Bot. 25: 143. 1889.

All West Indian material examined (Cuba: C. Wright 193 ISOTYPE in FH, Earle & Murrill 143 in NY) was sterile.

Note on Authorship and Support.Portions of this report were used by A. Punugu and M.T. Dunn as partial fulfillment of the requirements for the Master of Science degree in the Graduate School of Tulane University. The drawings are those of A. Punugu. Pertinent parts from the theses were abstracted by A.L. Welden, who also redesigned the keys and figures. The collecting of specimens upon which this paper is based was made possible by a grant (1960-63) to A.L. Welden from the National Science Foundation.

MYCOTAXON

Vol. X, No. 2, pp. 455-458 January-March 1980

TWO NEW SPECIES OF CERCOSPORA

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ABSTRACT

Cercospora pentasii Rajak and C. amaryllicola Rajak from the living leaves of Pentas lanceolata and Amaryllis belladona respectively, are described and illustrated here.

INTRODUCTION

During a survey of phytopathogenic fungi in and around Jabalpur, the author has collected many Cercosporae out of which two are new to science and described and illustrated here.

TAXONOMIC PART

Cercospora pentasii sp. nov. (Fig. I)

Coloniae effusae, griseae vel albae. Hypostromata olivaceo brunnea, minuta, 15-30 µm lata. Conidiophora fasciculata, 6-12 conidiophora per fasciculata, multiseptata, olivacea brunnea vel brunnea, apicem versus pallidiores, nonramosa, simplicia, recta vel flexuosa, geniculata, cicatrice eminente ad antice vel conidiis, 72-350 X 5-8.5 µm. Conidia hyalina, latus infra-fastigiata sursum, filiformes, recta vel curvata, 8-28 septata, ad basim truncata, apicem rotundata, distincta ad basim cicatrice, acropleurogena, 60-175 X 4-6 µm.

In foliis viventibus Pentate lanceolata (Forsk.) K. Schum., College garden, Jabalpur, January 1978, Leg. R. C. Rajak.

Typus positus in herb. IMI subnumero 225291.

Infection spots amphigenous, elongated to irregular, 2-6 cm., greyish brown, margin brownish black, rarely coalescing.

Colonies effuse, greyish to dull white. Stroma olivaceous brown, composed of few cells, 15-30 µm wide. Conidiophores fasciculate, in fascicles of 6-12, multiseptate, olivaceous brown, lighter at the apex, unbranched, simple, straight or flexuous, geniculate, with prominent scar of attachment to conidia, 72-350 X 5-8 µm. Conidia hyaline, broader below and tapering above, filiform, straight or curved, 8-28 septate, base truncate, apical ends rounded, distinct scar at base, acropleurogenous, 60-175 X 4-6 µm.

On the living leaves of Pentas lanceolata (Forsk.) K. Schum., College garden, Jabalpur, January 1978, Leg. R. C.

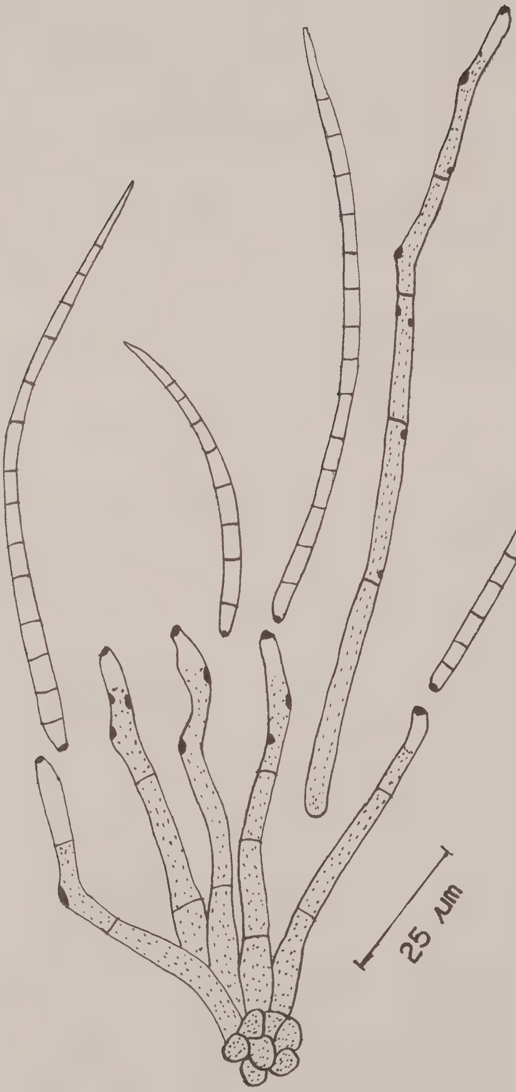

FIGURE 1. Cercospora pentasii. Conidia and conidiophores.

Rajak.

The type specimen has been deposited in the herbarium IMI No. 225291.

There is no report of any Cercospora parasitizing Pentas. It is, therefore, being described here as a new species, C. pentasii, named after the host plant.

Cercospora amaryllicola sp. nov. (Fig. 2)

Coloniae effusae, griseo nigrae, amphigenae. Hypostromata fusco brunnea vel griseo nigra, bulbiformae, pseudoparenchymatica, 64-112 µm lata. Conidiophora fasciculata, 6-15 conidiophora per fasciculata, multiseptata, olivacea brunnea vel brunnea, apicem versus pallidiores, nonramosa, simplicia, recta vel curvata, geniculata, cicatrice eminente ad antice vel conidiis, 224-640 X 5-7 µm. Conidia hyalina, latus infra-fastigiata sursum, filiformes, recta vel flexuosa, 6-25 septata, ad basim conicotruncata, apicem subacuta vel acuta, distincta ad basim cicatrice, acropleurogena, 72-450 X 4-6.5 µm.

In foliis viventibus Amarylli belladona Linn., Tagore garden, Jabalpur, January 1978, Leg. R. C. Rajak.

Typus positus in herb. IMI subnumero 225290.

Die-back of foliage was observed. Infection started from tips and extended downwards. Lesions olivaceous brown to greyish brown, halo not distinct.

Colonies effuse, greyish black, amphigenous. Stromata dark brown to greyish black, bulbous, pseudoparenchymatous, 64-112 µm wide. Conidiophores fasciculate, in fasciciles of 6-15,

64-112 µm wide. Conidiophores fasciculate, in fascicles of 6-15,
multiseptate, olivaceous brown to brown, lighter at apex, simple, straight or flexuous, geniculate, with prominent scar of attachment to conidia, 224-640 X 5-7 µm. Conidia hyaline, broader below and tapering above, filiform, straight or curved, 6-25 septate, base conico-truncate, subacute to acute, distinct scar at the base, acropleurogenous, 72-450 X 4-6.5 µm.

On the living leaves of Amaryllis belladona Linn., Tagore garden, Jabalpur, January 1978, Leg. R. C. Rajak.

The type specimen has been deposited in the herbarium IMI No. 225290.

As far as known, there is no report of any Cercospora parasitizing Amaryllis. It is, therefore, being described here as a new species, C. amaryllicola, named after the host plant.

ACKNOWLEDGMENTS

I am grateful to Dr. G. P. Agarwal, Head, Department of Post-graduate Studies and Research in Botany, University of Jabalpur, for his kind interest and encouragement and to Mr. A. Johnston, Director, and Dr. B. C. Sutton, Commonwealth Mycological Institute, Kew, England, for their help in the identification of the species.

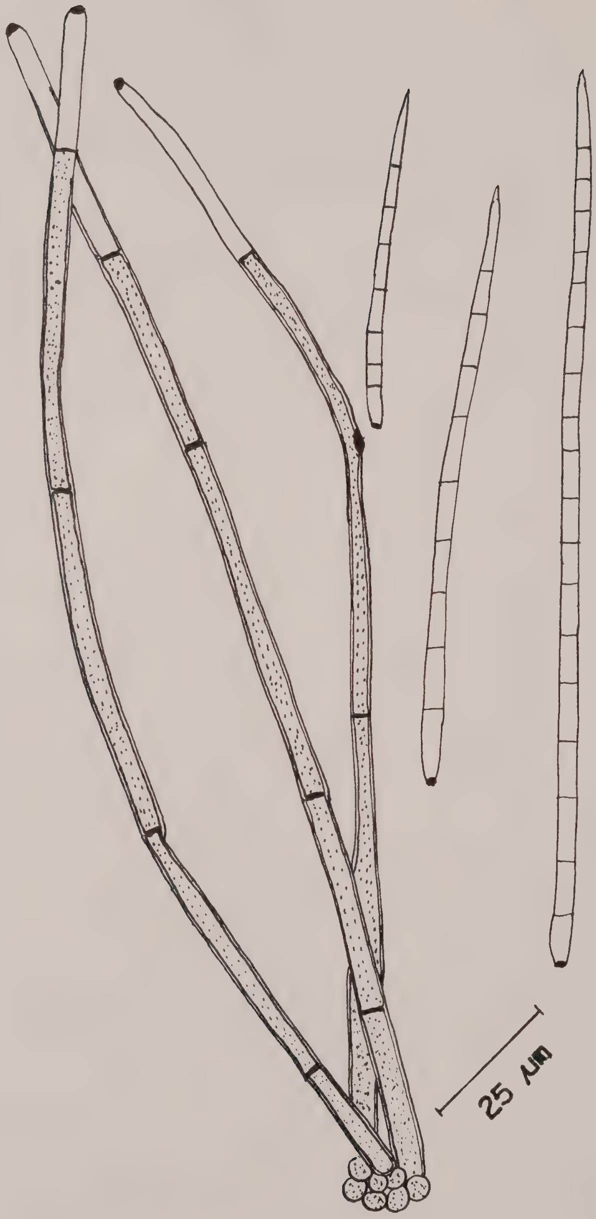

FIGURE 2. Cercospora amaryllicola. Conidia and conidiophores.

MYCOTAXON

Vol. 10, No. 2, pp. 459-472 January-March 1980

MOLLISIA IN MACARONESIA: AN EXERCISE IN FRUSTRATION

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ABSTRACT

Twenty-seven taxa assumed to be of specific rank and referable to the genus Mollisia (Discomycetes: Helotiales, Dermateaceae) were delimited among collections from the Canary Islands and Madeira. Since there is no comprehensive monograph of the genus, an attempt at species identification was made by comparing sections of these Macaronesian collections with collections issued in European exsiccati. In no case was a match found with any of these previously identified, published collections. Comparisons were also made with 6 specimens collected and identified by Dennis from another Macaronesian island archipelago, the Azores. Three of our taxa appear to fit Dennis's concepts of described species. One of the collections from Madeira differs from any known species of the genus in having ascospores which are dextrinoid when mounted in iodine solutions; in culture it produces an anamorph close to Phialophora verrucosa, and the holomorph is described here as a new species, **Mollisia dextrinospora**. Illustrations of all 27 taxa are provided, 23 of which are merely cited as "taxonomic species" A, B, etc.

Species identification in genera of the Helotiales in which recent monographs are not available can be time-consuming and often unproductive work. One of the largest genera of the Helotiales lacking any kind of comprehensive treatment is Mollisia (Fr.) Karst., even in the sense that excludes the subiculate forms (Tapesia), the multiseptate-spored forms (Niptera), and the erumpent forms (Pyrenopeziza) that are only doubtfully worthy of recognition as separate genera. The junior author has (and suspects most of his colleagues who collect Discomycetes in earnest also have) hundreds of collections in his herbarium identified only to "Mollisia sp.," ever hopeful that a major monograph will appear that will allow identification of these collections to species.

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The junior author has in preparation a preliminary Discomycete Flora of Macaronesia, based on collections which he and colleagues have made in three, successive, month-long expeditions to the Canaries, the Madeiras, and the Azores, together with a study of all available collections which have formed literature reports from any of the Macaronesian islands. Other collections from colleagues who have collected in these island groups were also solicited and examined.

How to proceed with species identification of Macaronesian collections of *Mollisia* was given much thought. As a first step, all collections were examined under the light microscope (often using phase microscopy) from freezing-microtome sections (and squash mounts, where appropriate). Salient features of apothecial structure, including measurements of all appropriate micro-anatomical structures, were made. These studies permitted us to delimit 27 taxa which we feel may be worthy of species rank. Many of the taxa were represented by single collections, others by many collections. For each of the taxa the senior author prepared illustrations of the apothecium in median vertical section, and illustrations of the asci and ascospores (FIGS. 1-27). For one species, described below as new, and for which pure cultures had been obtained, illustrations were also prepared of its *Phialophora* anamorph (FIG. 1).

Sections were then made of all available published exsiccati of *Mollisia* from European sets in this herbarium (CUP) for comparison of these with our Macaronesian collections. These included what one might expect to be the commonest species one would encounter, *Mollisia cinerea*, *M. melaleuca*, *M. melaleucoides*, etc. Since several species of the genus had been reported by Dennis et al. (1977) from the Azores, six collections sent on loan from Kew were also sectioned and given comparative examination.

Our results were both unexpected and disheartening: not a single published exsiccatum matched any of our 27 purported species sufficiently to warrant assuming they represented the same taxon. While it is clear that the Macaronesian Discomycete flora may be expected to differ from the European flora which we sampled by choosing European exsiccati, we had expected to find some correlation at least. (The higher plant flora is said to have more than 50% of its species endemic in Macaronesia.) Our results with the 6 collections

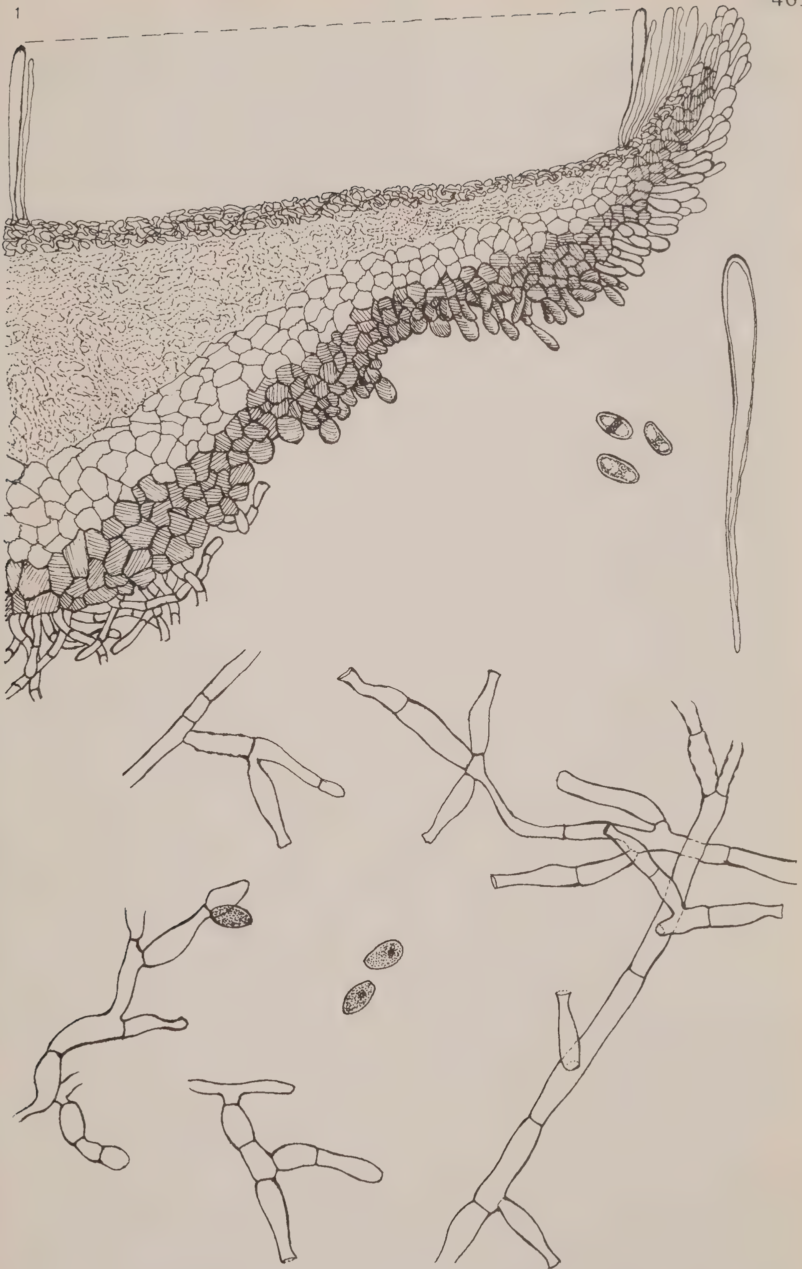


Fig. 1. Mollisia dextrinospora. Vertical section of apothecium × 500, 3 ascospores, ascus × 1000; phialides and phialoconidia of Phialophora in culture × 1000.

that Dennis had collected in the Azores were somewhat more encouraging. His collection (CUP-MM 1697) identified as Mollisia melaleuca did not fit any of our collections. Both of the collections he identified as M. ventosa (CUP-MM 1683, 1684) have 3-septate ascospores so that we would have excluded them and treated them as representatives of Niptera (but we do not feel that the two collections are conspecific). Dennis's collection identified as M. fallens (CUP-MM 1696) matches one of our taxa, and another identified as M. cinerea (CUP-MM 1695) matches another of our taxa. A third match is with what Dennis has identified as M. trabincola (CUP-MM 1698), but both his collection and the three of ours that seem to match differ so widely from the original diagnosis (Rehm, 1891) that we feel this cannot be the correct name for our taxon.

One of our collections from Madeira differs significantly from any species of the genus known to us: its ascospores are dextrinoid when mounted in iodine solution (Melzer's Reagent). The reaction was noted at the time the collection was examined in the field laboratory, and this prompted the junior author to obtain pure cultures at that time from ascospores shot onto agar. These yielded a species of Phialophora, which has been identified for us by Dr. W. Gams, Centraalbureau voor Schimmelcultures, Baarn, as close to P. verrucosa Medlar, but differing from that species in having less flaring collarettes and often longer phialides. The Madeiran collection is described here as a new species, Mollisia dextrinospora Korf. The anamorph, a member of the Phialophora fastigiata group (Schol-Schwarz, 1970) is not separately named.

Mollisia dextrinospora Korf, sp. nov. (FIG. 1)

Apothecia 0.3-1.0mm diam., dispersa vel gregaria, aliquando confluentia, applanata, translucentia, grisea. Excipulum e textura globulosa compositum, cellulis brunneis, 11-20μm diam. Asci 44-55×2.9-3.7(-4.4)μm, clavati, 8-spori, sine unco, poro J-. Ascosporae hyalinae, ovoideae, biseriatae, biguttulatae, in solutione iodi dextrinoideae, (3.7-) 4.4-5.9(-6.6)×2.6-2.9μm. Paraphyses filiformes. Status anamorphosis: Phialophora.

HOLOTYPE: On decayed wood of mimosa (Acacia sp.), 1.5 km above Monte, at km mark 5.5 toward Terreiro da Luta, Madeira. 16.i.1977. Leg. R.P. Korf, R. Fogel, G.L. Hennebert & L.M. Kohn. CUP-MM 1557.

ISOTYPE: Ibid., TFC-MM 1557.

CULTURE: derived from the holotype on deposit in CBS, accession number 401.78.

NOTES: The ascus pore does not blue with iodine even if material is pretreated with 10% KOH (Kohn & Korf, 1975). The dextrinoid reaction of ascospores in Melzer's Reagent is intensely yellow-brown, and there is also a slight dextrinoid reaction in the subhymenium and medullary tissues. When sections are pretreated in 10% KOH the dextrinoid reactions of those tissues is essentially eliminated, and the spores are less intensely dextrinoid. The dextrinoid reaction is evident in maturing and mature ascospores, not in young ones.

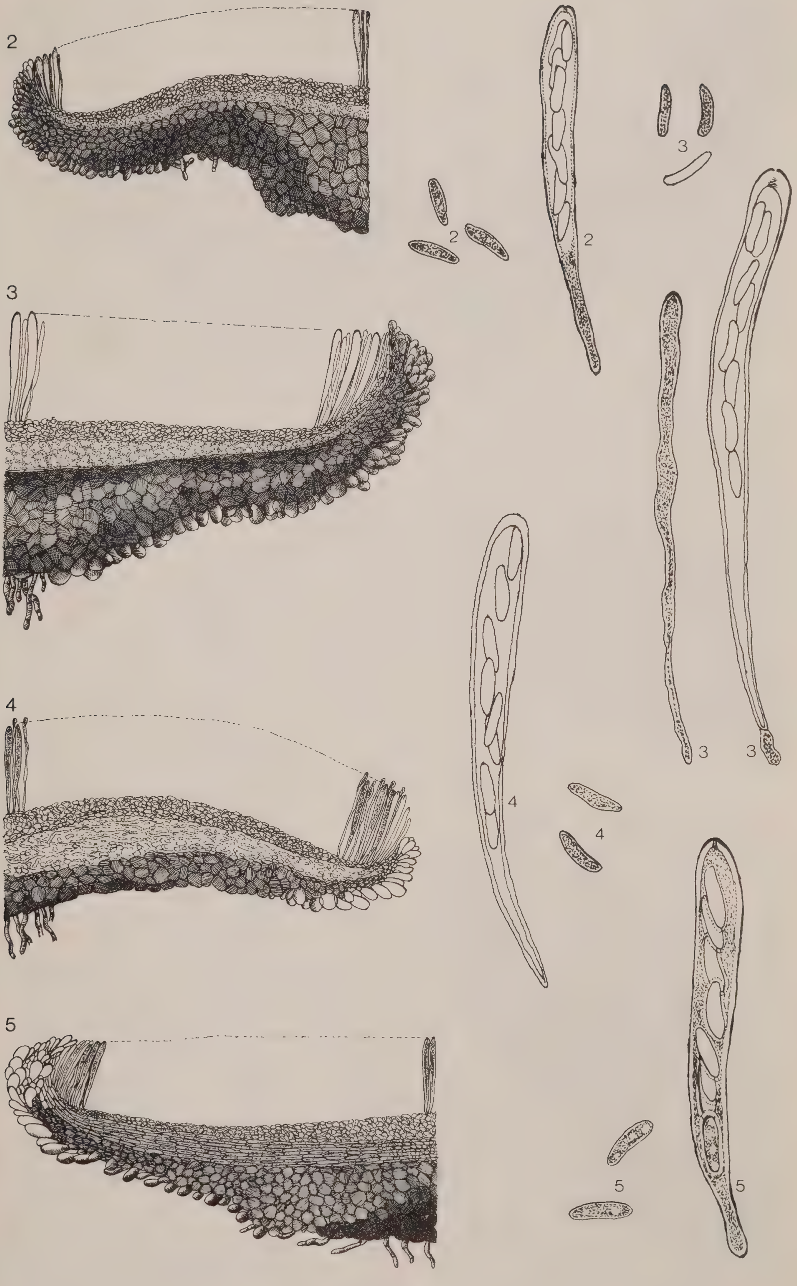
Our studies have revealed that there are a large number of characters of the apothecia that may prove useful in delimiting species within the genus Mollisia, even though many have never been stressed by taxonomists. We have taken note not merely of the gross characters of apothecia (size, shape, colors of the hymenium and excipulum) and of hymenial features (sizes and shapes of asci, ascospores, spore septation, paraphyses, reactivity of the ascus pore to iodine) but also of the sterile tissues of the apothecium as seen in median section. Probably useful, but not taken into account in our studies, are the cell arrangements seen when the apothecia are viewed from below in squash mounts. Basal hyphae may be absent or present, and if so may or may not be embedded in gel; free hyphae may be present on the flanks, giving rise to hair-like outgrowths; excipular cells at the base vary greatly among collections in cell size and wall thickness, while those on the flanks and again at the margin may vary in shape and degree of pigmentation (from dark brown to hyaline); the thickness of the medulla, and its layering, also varies greatly among collections.

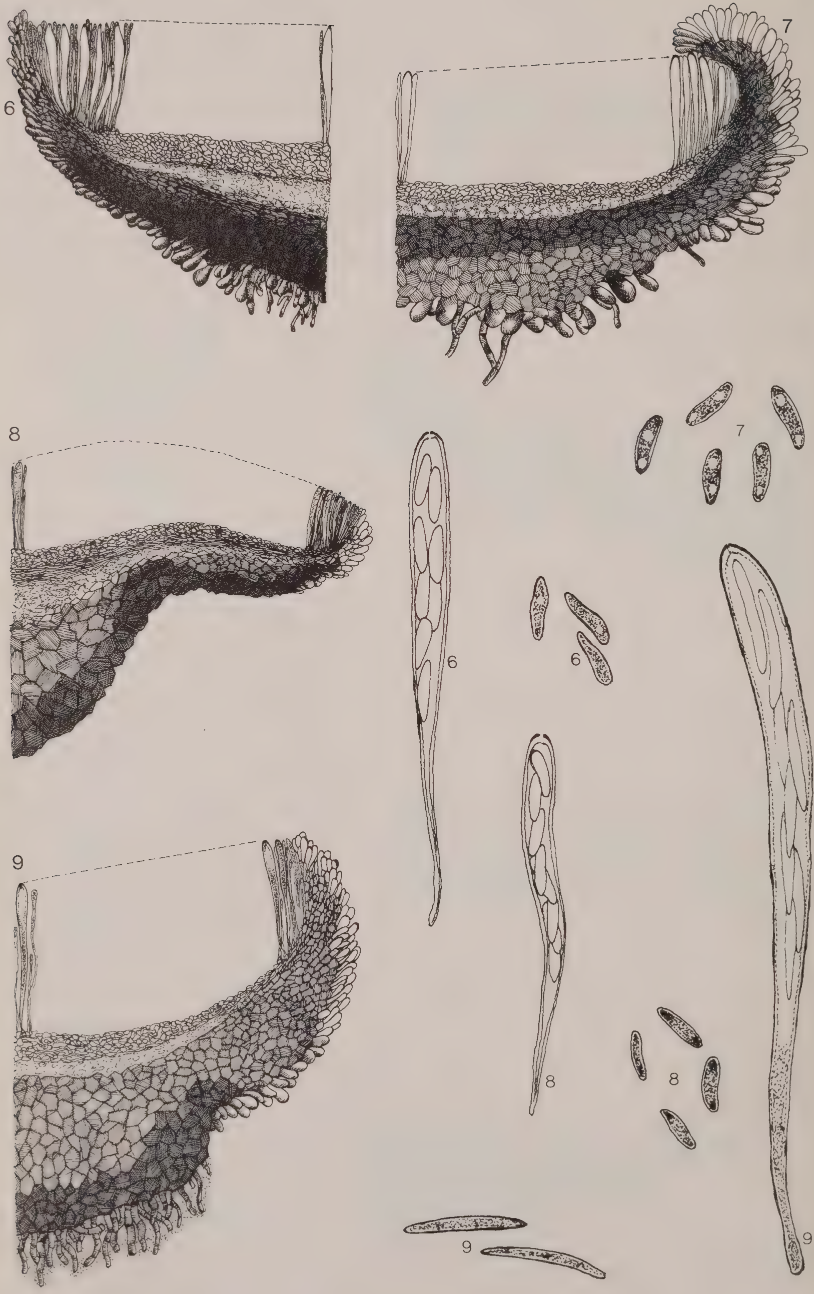
We are clearly not at a point where we can confidently assert that the taxa we have identified represent species rather than populations. They have the "feel" of being real species, but until someone undertakes monographic studies in this most complex genus, we prefer merely to record here our observations in a series of illustrations which will give some notion of the scope of variation to be found among our collections (FIGS. 1-27). Though an artificial key could easily be constructed to these "taxa," derived from our data, providing such a key would serve no real purpose: our intent is to point out how little, not how much, we know about Mollisia today. Monographic work must necessarily involve much more work, and more sophisticated work, than we have attempted here. For example, in most cases no pure cultures were made of the species of this genus which were collected on the Macaronesian expeditions. Pure cultures are certain to yield much critical information, as has already been shown in the pioneering work by Le Gal & Mangenot (1956, 1958, 1960, 1961, 1966). Had it not been for our noting the peculiar dextrinoid reaction of the ascospores of *M. dextrinospora* in the field laboratory before drying, no cultures would have been obtained of it, either.

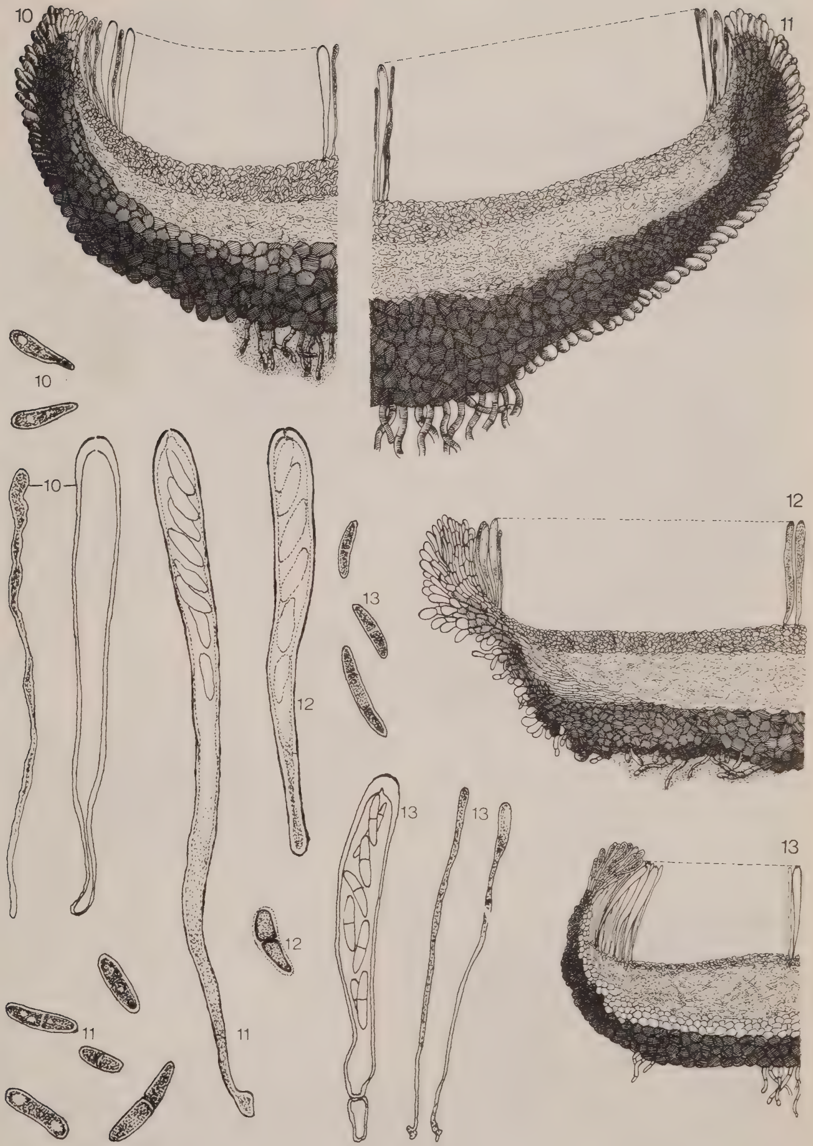
That many species of *Mollisia* and *Mollisia*-like genera yield anamorphs referable to *Phialophora* is well-established (Hennebert & Bellemère, 1979). If, as we believe, progress in the taxonomy of *Mollisia* will only be possible with concomitant study of the *Phialophora* anamorphs, the converse may be equally true: "I am sure that a study of *Mollisia* would be the only means of really advancing the knowledge of *Phialophora*" (W. Gams, *pers. comm.*). Is there a budding mycologist interested in monographing a large and important genus of Hyphomycetes (*Phialophora*) also willing to isolate from and do a monograph of *Mollisia*?

Some of the Macaronesian collections from the Canary Islands and Madeira were poorly preserved or so immature that we still cannot hazard a guess as to their identity beyond genus. A few taxa that we feel deserve species rank have not been illustrated because the material was too scanty. The 27 taxa that we fair-confidently recognize and which we have delimited here are represented by collections on deposit in CUP, with duplicates in some cases in O, OSC, or TFC. Collection data appears on the packet labels, and is not reproduced here except for an indication of the island on which the collection was taken. Numbers in bold face indicate the collection from which the illustrations were made.

Figs. 2-5. *Mollisia* spp., apothecia x 250, asci, ascospores and paraphyses x 500. 2. Tax. sp. A. 3. Tax. sp. B. 4. Tax. sp. C. 5. *M. trabincola* sensu Dennis.



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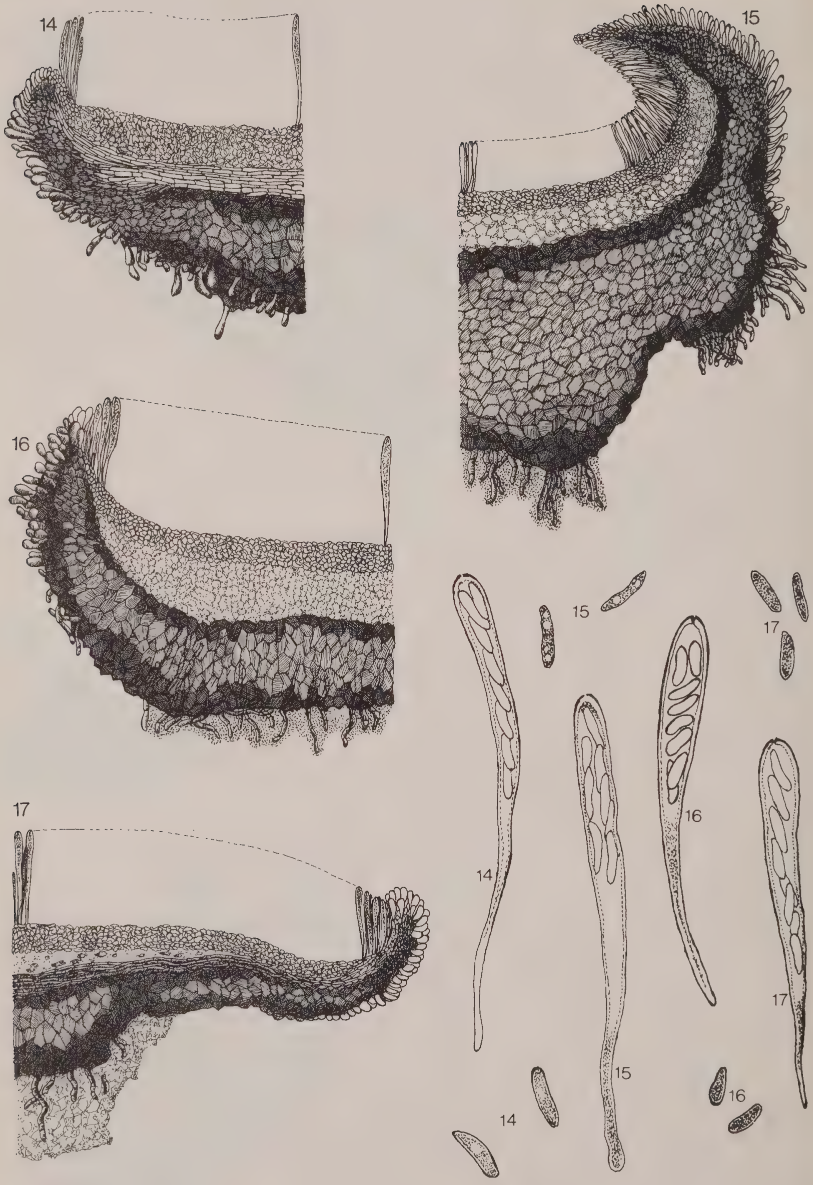
Figs. 6-13. *Mollisia* spp., apothecia x 250, asci, ascospores and paraphyses x 500. 6. Tax. sp. E (var.). 7. Tax. sp. E. 8. Tax. sp. F. 9. Tax. sp. G. 10. *M. cinerea* sensu Dennis. 11. Tax. sp. J. 12. Tax. sp. K. 13. Tax. sp. L.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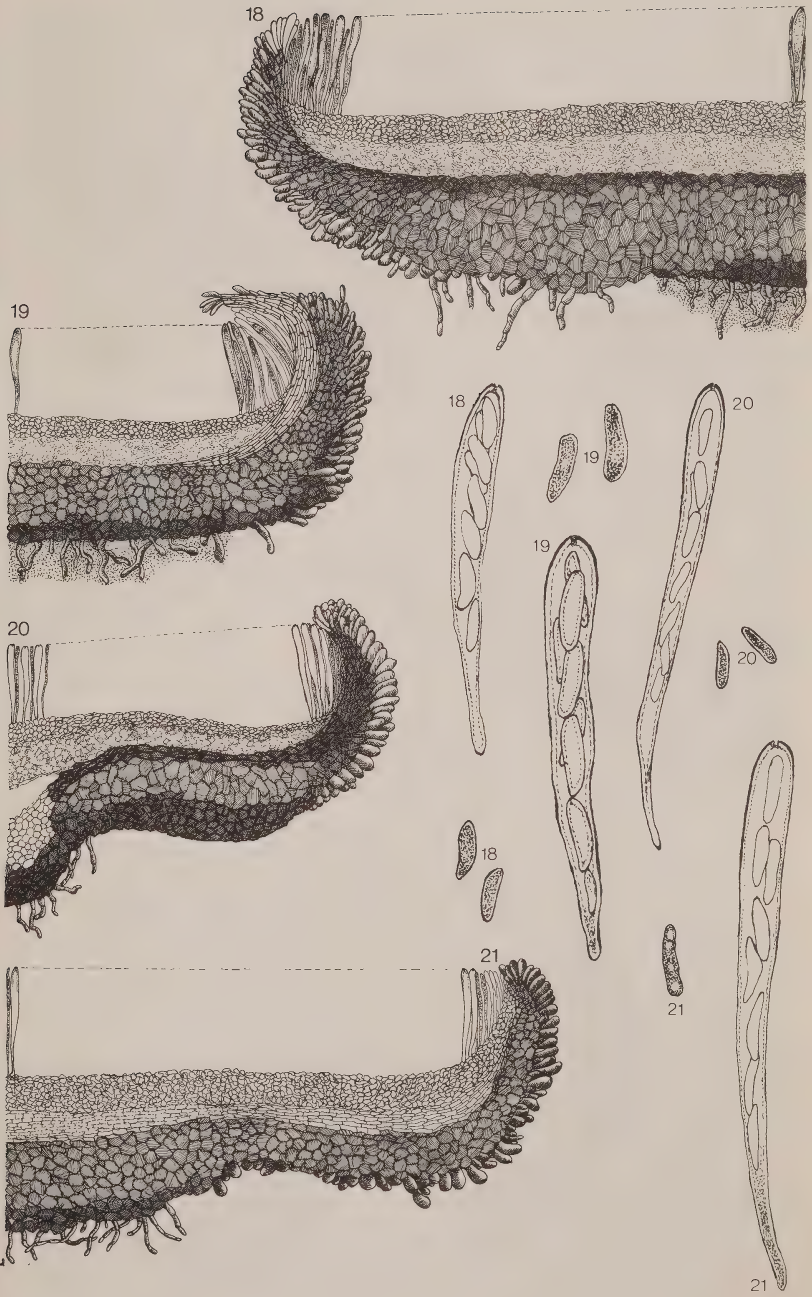
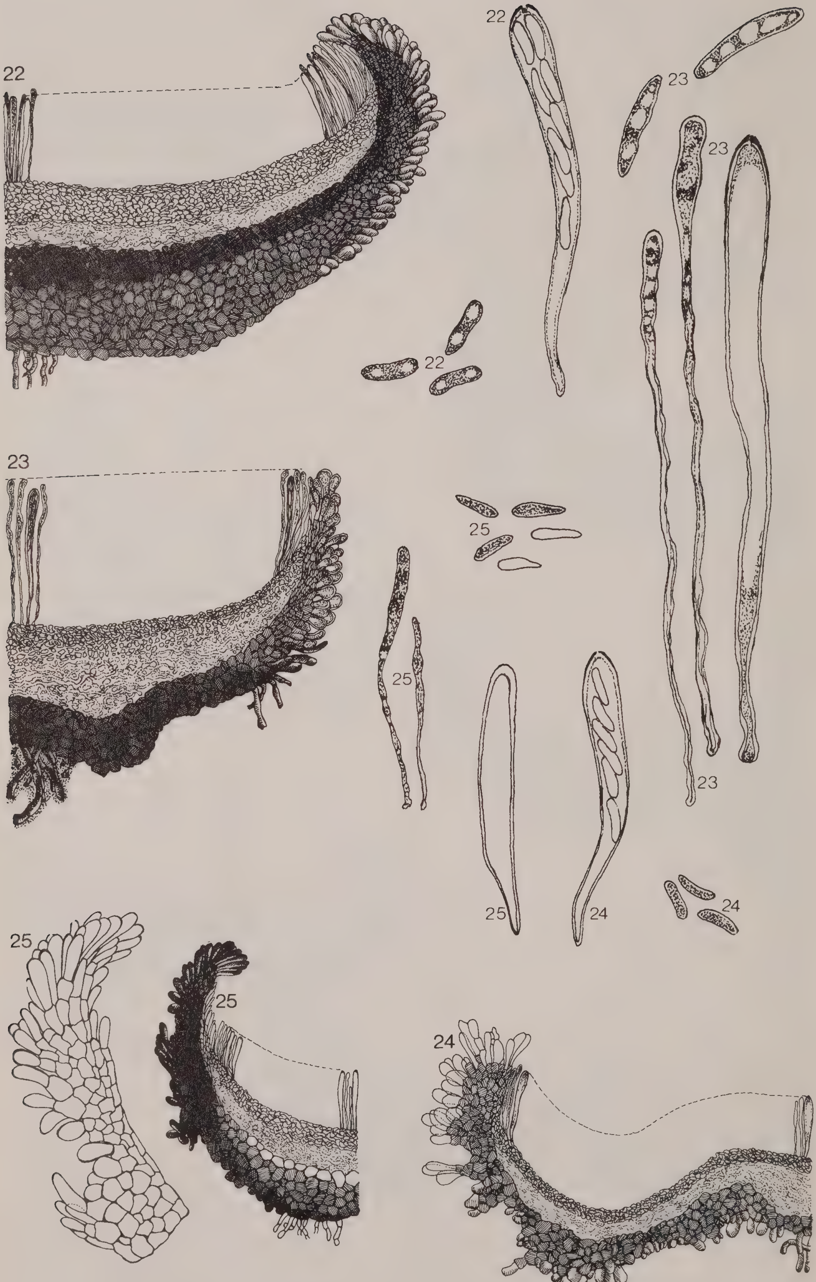
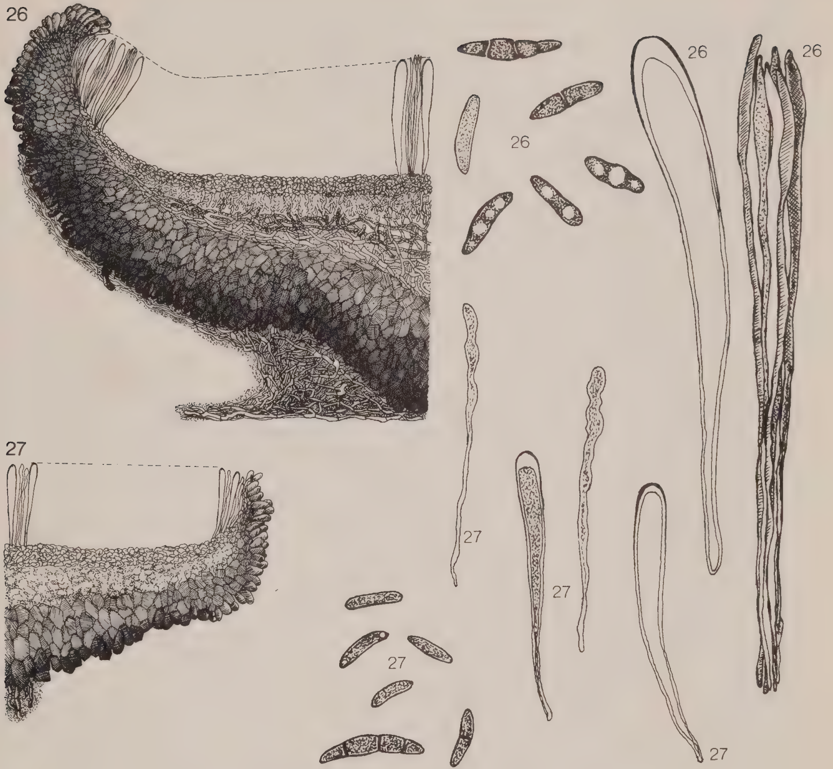
Figs. 14-21. Mollisia spp., apothecia x 250, asci, ascoispores and paraphyses x 500. 14. Tax. sp. M. 15. Tax. sp. N. 16. Tax. sp. P. 17. Tax. sp. Q. 18. Tax. sp. R. 19. Tax. sp. S. 20. Tax. sp. T. 21. Tax. sp. U.







↑ Figs. 26-27. Mollisia spp., apothecia × 250, asci ascospores and paraphyses × 500. 26. Tax. sp. AA. 27. M. fallens sensu Dennis.

← Figs. 22-25. Mollisia spp. 22-24. Apothecia × 250, asci, ascospores, paraphyses × 500. 22. Tax. sp. W. 23. Tax. sp. X. 24. Tax. sp. Y. 25. Apothecium × 250, margin, ascus, ascospores, paraphyses × 500. Tax. sp. Z.

COLLECTION DATA

Fig. 1: Mollisia dextrinospora Korf. **1557:** Madeira.
Fig. 2: Taxonomic species A. **503:** Tenerife.
Fig. 3: Tax. sp. B. 89: Tenerife. **873:** La Palma.
Fig. 4: Tax. sp. C. 111, 1258: Tenerife. **667,** 1094: La
Fig. 5: Mollisia trabincola Rehm sensu Dennis. **220:** Tenerife. 1485, 1536, 1559: Madeira.
Fig. 6: Tax. sp. E (var.). **227:** Tenerife. 660, 899: La Palma.
Fig. 7: Tax. sp. E. **224,** 525, 605: Tenerife. 1344: Gomera.

Fig. 8: Tax. sp. F. **242**: Tenerife.
Fig. 9: Tax. sp. G. **95**, 249, 1259: Tenerife.
Fig. 10: *Mollisia cinerea* (Batsch ex Mérat) Karst. *sensu* Dennis. **303**: Tenerife.
Fig. 11: Tax. sp. J. **335**: Tenerife.
Fig. 12: Tax. sp. K. **490**: Tenerife.
Fig. 13: Tax. sp. L. 501, 513, 1109, 1229, **1328**: Tenerife. 1346: Gomera. 1488, 1493, 1603, 1620, 1622, 1640: Madeira.
Fig. 14: Tax. sp. M. **560**: Tenerife.
Fig. 15: Tax. sp. N. **606**, 1648: Tenerife.
Fig. 16: Tax. sp. P. **614**: Tenerife.
Fig. 17: Tax. sp. Q. **656**: La Palma.
Fig. 18: Tax. sp. R. **665**, 676: La Palma. 1342: Gomera.
Fig. 19: Tax. sp. S. **680**: La Palma. 1315: Tenerife.
Fig. 20: Tax. sp. T. **901**: La Palma.
Fig. 21: Tax. sp. U. **1174**: Gomera.
Fig. 22: Tax. sp. W. **1199**, 1293: Tenerife.
Fig. 23: Tax. sp. X. **1266**: Tenerife.
Fig. 24: Tax. sp. Y. **1428**: Hierro.
Fig. 25: Tax. sp. Z. **1625**: Madeira.
Fig. 26: Tax. sp. AA. **1631**: Madeira.
Fig. 27: *Mollisia fallens* (Karst.) Sacc. *sensu* Dennis. **1598**: Madeira.

ACKNOWLEDGEMENTS

The National Science Foundation, through grant DEB 75-23557, "Discomycete Flora of Macaronesia," sponsored not only three explorations, each a month in length and each by the junior author and three colleagues, but also provided financial support for two exceptionally able technicians, Susan Gruff (who sectioned most of the early collections) and Robert Dirig (the later ones, and who also gave technical assistance in preparing the illustrations for publication). The cooperation of the scientists at TFC and MADM was deeply appreciated and an essential to the programs. Dr. William Dress, BH, helped in checking the Latin diagnosis.

REFERENCES CITED

DENNIS, R.W.G., D.A. REID, & B. SPOONER. 1977. The fungi of the Azores. Kew Bull. **32**: 85-136.
HENNEBERT, G.L. & A. BELLEMERE. 1979. Les formes conidiennes des Discomycètes. Essai taxonomique. Rev. Mycol. (Paris) **43**: 259-315.
KOHN, L.M. & R.P. KORF. 1975. Variation in Ascomycete iodine reactions: KOH pretreatment explored. Mycotaxon **3**: 165-172.
LE GAL, M. & F. MANGENOT. 1956. Contribution à l'étude des Mollisioïdées. I. Note préliminaire: les formes conidiennes. Rev. Mycol. (Paris) **21**: 3-13.
_____ & _____. 1958. *Ibid.*, II (1re série). Rev. Mycol. (Paris) **23**: 28-86.
_____ & _____. 1960. *Ibid.*, III (2e série). Rev. Mycol. (Paris) **25**: 135-214.
_____ & _____. 1961. *Ibid.*, IV (3e série). Rev. Mycol. (Paris) **26**: 263-331.
_____ & _____. 1966. *Ibid.*, V (4e série). Rev. Mycol. (Paris) **31**: 3-44.
REHM, H. 1891. Ascomyceten: Hysteriaceen und Discomyceten. *In* Winter, G. & H. Rehm, Rabenhorst's Krypt.-Fl. Deutschl., ed. 2, **1**(3)[Lief. 35]: 465-528.
SCHOL-SCHWARZ, M.B. 1970. Revision of the genus *Phialophora* (Moniliales). Persoonia **6**: 59-94.

MYCOTAXON

Vol. 10, No. 2, pp. 473-478 January-March 1980

CYTOSPORA VS. CYTISPORA: WHICH IS CORRECT?

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A recent listing of diseases of apple and their associated pathogens in Phytopathology News (Parker 1979) aroused my interest with the statement that Cytispora is the correct spelling, rather than the more familiar Cytospora, for the agent of a common canker disease of apple. Since the genus includes several other pathogens of worldwide importance on cultivated and forest trees, there may be quite a few researchers wondering what those troublesome taxonomists are up to now. Because the "correct" spelling was indicated without reference or explanation, readers of Phytopathology News had no way of understanding the rationale for a change or of the making of an intelligent choice in the matter. I am at present involved in a taxonomic study of the genus, and therefore felt it worthwhile to investigate the question further, in the hope that I might help to clarify it for others as well.

The name Cytospora is a pre-starting point name, published by Ehrenberg (1818). The derivation of the name was not given in the original publication, but it is evidently a combination of the Greek words cytos (receptacle, cavity) and spora (seed) as mentioned by Saccardo (1884). Fries (1823) validated the name in the "Systema Mycologicum," referring to Ehrenberg's description, but spelling it Cytispora, giving no reason for the alteration. Dr. Kevin Clinton of the Classics Department of Cornell University has informed me that cytis is the diminutive form of cytos, and that while both are permissible, the combination 'Cytospora' is more acceptable. Therefore Fries's choice of Cytispora was apparently not based on linguistic correctness. He either preferred the spelling Cytispora or persisted in an unintentional orthographic change, since he employed it in the "Elenchus Fungorum" (1828) and the "Summa vegetabilium Scandinaviae" (1849) as well.

The history of both spellings from 1818 to the present is summarized in Table 1. From this we can see that in works immediately following Fries the spelling Cytispora was used, but Saccardo's (1884) revival of the original spelling in the "Sylloge Fungorum" was adhered to by nearly every subsequent author. Three authors (Saccardo, Lambotte, Feltgen) employed Cytispora in early works but adopted Cytospora in later works or supplements. Nowhere did the reverse occur.

Inquiries into the source of the statement in Phytopathology News revealed that Dr. F.A. Uecker, a USDA mycologist at Beltsville, had changed the spelling in Parker's (1979) list in the process of a routine taxonomic check required by the editors of the newsletter. The alteration was not applied consistently, however, appearing only in Parker's list; in the lists for peach and rose in the same and succeeding issues (Clayton 1979, Gill 1979) the generic name is spelled Cytospora. In support of his position Dr. Ueker has supplied me with a reference to an article by Jørstad (1962) in which a footnote reads: "Cytispora is the correct spelling, validated by Fries in Syst. Myc., 2 p. 540, 1823. Cytospora is due to Ehrenberg in Sylvae Myc. Berol. p. 28, 1818." In the absence of any further explanation I assume that Jørstad was referring to what is now Art. 13.1(f) of the International Code of Botanical Nomenclature (Stafleu 1978) which gives preferential status to the names published in Fries's "Systema Mycologicum" for this group of fungi. Additionally, Art. 73.1 and 73.2 direct that the original spelling in the validating publication be retained, except for the correction of typographic or orthographic errors. The crucial question is, does Fries's altered spelling constitute either a typographic or an orthographic error? The Code does not help to resolve this question, so I searched instead for precedents which might indicate how the problem had been handled in the past. There are at least two cases in which similar discrepancies in spelling have occurred.

1. Dacryomyces vs. Dacrymyces
   Both the pre-strating point spelling Dacryomyces (Nees von Esenbeck 1817) and Fries's (1821) spelling Dacrymyces are and have been in common use. Donk (1958) considered them orthographic variants, but preferred Fries's version.

2. Helmisporium vs. Helminthosporium
   Link (1809) published the name Helmisporium, which

TABLE 1: History of the use of *Cytispora* and *Cytospora*

CYTOSPORA	CYTISPORA
Ehrenberg (1818)	
	Fries (1823)
	Brongniart (1824)
	Fries (1828, 1849)
	Bonorden (1851)
	Nees & Henry (1858)
	Streinz (1862)
	Fuckel (1870)
	*Karsten (1873)
	Saccardo (1879)
	Lambotte (1880)
Saccardo (1884)	
Lindau (1889)	
Lambotte (1890)	
	*Ellis & Everhart (1892)
Schroeter (1894)	
Allescher (1898)	
	Feltgen (1899)
Feltgen (1903, 1905)	
Clements (1909)	
Diedicke (1912)	
Migula (1913)	
von Höhnel (1928)	
Clements & Shear (1931)	
*Défago (1935)	
Grove (1935)	
Gutner (1935)	
*Kern (1955)	
*Munk (1957)	
*Hubbes (1960)	
	Jørstad (1962)
Sutton (1973)	
von Arx (1974)	
*Wehmeyer (1975)	
Sutton (1977)	
*Barr (1978)	
*Dennis (1978)	

* These authors mentioned the anamorphic genus in the context of a work dealing principally with the teleomorphic genera *Valsa* and *Leucostoma*.

was picked up and validated by Fries (1821) with the same spelling. Later Fries (1832) used Persoon's (1822) changed spelling, *Helminthosporium*, which is now more commonly encountered. Hughes (1958) wanted to abolish the priviledged status of Fries's "Systema" and adopted an 1801 starting point for Hyphomycetes, and restored the original spelling of Link. Because of the problems in indexing and the preponderance of the use of the later spelling, Donk (1964) proposed conservation of *Helminthosporium* Fries 1832 over *Helmisporium* Fries 1821; that conservation has now been effected and appears in the Code.

The examples described above illustrate two differing solutions to the problem of typographic and orthographic variants of names sanctioned by virtue of their use in Fries's "Systema Mycologicum." The first is a case in which Fries's version has been preferred over the original by many, but not all, authorities. In the second example Fries himself used both spellings, but the earlier one has enough weight, due to its priority and its identity with the original, prestarting point version, that it was felt necessary to conserve the later, more common spelling through action by a Botanical Congress. Examination of these precedents has shown us that the Code has been variously interpreted on the subject of typographic and orthographic corrections of the names sanctioned by Fries. In the case of *Cytospora*/*Cytispora*, Fries's spelling, although much used during the nineteenth century, has been let go since Saccardo, in favor of the original spelling of Ehrenberg. Donk (1964) treated *Cytispora* as an incorrect orthographic variant, a position which represents the unspoken consensus in the recent literature. Since the Code allows for orthographic corrections, and the spelling *Cytospora* conforms to the original spelling as well as being in common use, I feel that there is no justification for a change to *Cytispora*. The problems which would result from such a change are mind-boggling. Since the anamorph is the state most commonly found in the field, the phytopathological literature is generally found under the name *Cytospora* rather than the teleomorphic names *Valsa* and *Leucostoma*. Phytopathologists and mycologists who work with this very common and economically important group of organisms would have to adopt a spelling which differed from the one in use in all of the recent literature. Even the common name, '*Cytospora* canker,' would have to be changed to '*Cytispora* canker,' as the editors of Phytopathology News already, unfortunately, have done (Parker 1979). Indices would have to be revised, and gaining access to the literature would become more time-consuming. Therefore, if it were held that Fries's change was an intentionally introduced orthographic variant (no such evidence has been put forward) and if we were thus forced to adopt the unfamiliar spelling *Cytispora*, I for one would immediately move to conserve *Cytospora*. I strongly recommend that my mycological and phytopathological colleagues relax and ignore the "advice" of Phytopathology News, and continue their use of the spelling *Cytospora*.

LITERATURE CITED

Allescher, A. 1898. Fungi imperfecti: Hyalin-sporige Sphaeroideen. In Rabenhorst, Krypt.-Fl. Deutschl., ed. 2, **1**(6)[Lief. 59-63].

Arx, J.A., von. 1974. The genera of fungi sporulating in pure culture. Lehre.

Barr, M.E. 1978. The Diaporthales in North America. Mycologia Memoir No. 7. Lehre.

Bonorden, H.F. 1851. Handbuch der allgemeinen Mykologie. Stuttgart.

Brongniart, A. 1824. Mycologie. (Bot.) In Dict. Sci. Nat. **33**: 492-588. [Unsigned.] Issued as a repaged reprint with new title and rewritten first page: Brongniart, A. 1825. Essai d'une classification naturelle des champignons. Paris.

Clayton, C.N. 1979. Common names of plant diseases. Peach (*Prunus persica* (L.) Batsch). Phytopath. News **13**: 130.

Clements, F.E. 1909. The genera of fungi. Minneapolis.

_____ & C.L. Shear. 1931. The genera of fungi. New York.

Défago, G. 1935. De quelques Valsées v.H., parasites des arbres à noyeau dépérissants. Beitr. Kryptogamenfl. Schweiz **8**(3).

Dennis, R.W.G. 1978. British Ascomycetes, ed. 2. Vaduz.

Diedicke, H. 1912. Pilze VII. Sphaeropsideae, Melanconidieae. Krypt.-Fl. Mark Brandenburg **9**(2).

Donk, M.A. 1958. The generic names proposed for hymenomycetes VIII. Auriculariaceae, Septobasidiaceae, Tremellaceae, Dacrymycetaceae. Taxon **7**: 164-178.

_____. 1964. Nomina conservanda proposita. I. Proposals in fungi. Deuteromycetes. Regnum Veg. **34**: 7-15.

Ehrenberg, C.G. 1818. Sylvae mycologicae Berolinensis. Berlin.

Ellis, J.B. & B.M. Everhart. 1892. The North American pyrenomycetes. Newfield.

Feltgen, J. 1899. Vorstudien zu einer Pilz-Flora des Grossherzogthums Luxemburg. I Theil. Luxemburg.

_____. 1903. *Ibid.*, Nachträge III. Luxemburg.

_____. 1905. *Ibid.*, Nachträge IV. Luxemburg.

Fries, E.M. 1821. Systema mycologicum. **1**. Lund.

_____. 1823. *Ibid.*, **2**(2). Lund.

_____. 1828. Elenchus fungorum. **2**. Greifswald.

_____. 1832. Systema mycologicum. **3**(2). Greifswald.

_____. 1849. Summa vegetabilium Scandinaviae. Sectio posterior. Uppsala.

Fuckel, L. 1870. Symbolae mycologicae. Jahrb. Nassauischen Vereins Naturk. **23-24:** 1-459.

Gill, D.L. 1979. Common names of plant diseases. Rose (Rosa spp.). Phytopath. News **13:** 139.

Grove, W.B. British stem- and leaf-fungi. I: Sphaeropsidales. Cambridge.

Gutner, L.S. 1935. Materialy k monografii roda Cytospora. Trudy Bot. Inst. Akad Nauk SSSR, Ser.2, Sporov. Rast. **2:** 411-484.

Höhnel, F., von. 1928. Über die für Europa beschreibenen Cytospora-Arten der Abietineen. Mitt. Bot. Inst. TH Wien **5:** 5-15.

Hubbes, M. 1960. Systematische und physiologische Untersuchungen an Valsaceen auf Wieden. Phytopath. Z. **39:** 65-93.

Hughes, S.J. 1958. Revisiones hyphomycetum aliquot cum appendice de nominibus rejiciendis. Canad. J. Bot. **36:** 727-836.

Jørstad, I. 1962. Icelandic parasitic fungi apart from Uredinales. Skr. Norske Vidensk.-Akad. Oslo, Mat.-Naturvidensk. Kl., n.s. **10:** 1-72.

Karsten, P.A. 1873. Mycologica Fennica. Pars secunda: Pyrenomycetes. Bidr. Kännedom Finlands Natur Folk **23:** 1-250.

Kern, H. 1955. Taxonomic studies in the genus Leucostoma. Pap. Michigan Acad. Sci. **40:** 9-22.

Lambotte, E. 1880. Flore mycologique Belge. **3.** Verviers.

_____. 1890. La flore mycologique de la Belgique. Suppl. **2.** Bruxelles.

Lindau, G. 1889. Pilze. In Engler und Prantl, Die natürlichen Pflanzenfamilien, ed. 1, **1**(1**).

Link, H.F. 1809. Observationes in ordines plantarum naturales. Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. **3:** 3-42.

Migula, W. 1913. Fungi imperfecti: Sphaeropsidales, Melanconiales. Thomé's Krypt.-Fl. Deutschl. **3**(4)[1].

Munk, A. 1957. Danish pyrenomycetes. A preliminary flora. Dansk Bot. Ark. **17:** 1-149.

Nees von Esenbeck, C.G. 1817. Das System der Pilze und Schwämme. Ein Versuch. Ueberblick des Systems der Pilze und Schwämme zur Erklarung der Kupfertafeln. Würzburg.

Nees von Esenbeck, T.F. & A. Henry. 1858. Das System der Pilze. Zweite Abteilung. Bonn.

Parker, K.G. 1979. Common names of plant diseases. Apple (Malus sylvestris Mill.). Phytopath. News **13:** 127-128.

Persoon, C.H. 1822. Mycologia europaea. **1.** Erlangen.

Saccardo, P.A. 1879. Fungi Gallici. Michelia **1:** 500-538.

_____. 1884. Sylloge fungorum. **3.** Padua.

Schroeter, J. 1894. Die Pilze Schlesiens. In Cohn, Krypt.-Fl. Schlesien. **3**(2)[Lief. 2].

Stafleu, F.A. [ed.] 1978. International Code of Botanical Nomenclature adopted by the twelfth International Botanical Congress, Leningrad, July 1975. Regnum Veg. **97:** 1-457.

Streinz, W.M. 1862. Nomenclator fungorum. Vienna.

Sutton, B.C. 1973. Coelomycetes. In Ainsworth, Sparrow & Sutton [eds.], The fungi **4A:** 513-582.

_____. 1977. Coelomycetes VI. Nomenclature of generic names proposed for Coelomycetes. Mycol. Pap. **141:** 1-253.

Wehmeyer, L.E. 1975. The pyrenomycetous fungi. Mycologia Memoir No. 6. Lehre.

MYCOTAXON

Vol. X, No. 2, pp. 479-501 January-March 1980

SYNOPSIS OF WOOD ROTTING-FUNGI ON SPRUCE IN NORTH AMERICA: III[1]

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SUMMARY

One hundred and fourteen species of wood-rotting basidiomycetes in the orders Tremellales, Agaricales, and Aphyllophorales (Polyporaceae and Corticiaceae excluded) are reported to occur on 8 species of North American spruces.

This is the last of a three-part synopsis of wood-rotting basidiomycetes on spruce in North America. The first part (Martin and Gilbertson, 1977) included keys to orders and to families of Aphyllophorales, and a synopsis of the family Corticiaceae. Part II (Martin and Gilbertson, 1978) was a synopsis of the family Polyporaceae sensu stricto. Part III includes keys to families, genera, and species of the order Tremellales; keys to families, genera and species of the order Agaricales; and keys to genera and species of the families Clavariaceae, Coniophoraceae, Echinodontiaceae, Hericiaceae, Hymenochaetaceae, Lachnocladiaceae, Punctulariaceae, Sparassidaceae, Steccherinaceae, Stereaceae, and Thelephoraceae of the order Aphyllophorales.

Species of spruce are denoted by numbers as follows: 1, *Picea breweriana;* 2, *P. engelmannii;* 3, *P. glauca;* 4, *P. mariana;* 5, *P. pungens;* 6, *P. rubens;* 7, *P. sitchensis;* 8, *P. chihuahuana;* 9, *Picea* sp.

Abbreviations designating geographical localities are AK, Alaska; AZ, Arizona; AT, Alberta; BC, British Columbia; CA, California; CO, Colorado; CH, Chihuahua; CT, Connecticut; ID, Idaho; MA, Massachusetts; MB, Manitoba; ME, Maine; MI, Michigan; MN, Minnesota; MT, Montana; NB, New Brunswick; NC, North Carolina; NF, Newfoundland; NH, New Hampshire; NJ, New Jersey; NM, New Mexico; NWT, Northwest Territories; NS, Nova Scotia; NY, New York; OR, Oregon; OT, Ontario; PA, Pennsylvania; PEI, Prince Edward Island; QB, Quebec; SK, Saskatchewan; SD, South Dakota; TN, Tennessee; UT, Utah; VT, Vermont; WA, Washington; WS, Wisconsin; WY, Wyoming; YT, Yukon Territory.

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[1] University of Arizona Agricultural Experiment Station Journal Article No. 3091.

Order Tremellales

Key to families

1. Basidia septate 2
1. Basidia not septate 3
    2. Basidia elongated, transversely septate . . AURICULARIACEAE
    2. Basidia subglobose to pyriform, longitudinally septate . . . . TREMELLACEAE
3. Basidia bifurcate . . . . DACRYMYCETACEAE
3. Basidia with four large, swollen epibasidia . . . TULASNELLACEAE

Family AURICULARIACEAE

Key to genera

1. Basidiocarps corticioid; basidia slightly coiled or circinate . . . . *Helicobasidium* Pat.

Helicobasidium corticioides Bandoni. Basidiocarps white to cream colored; hyphae simple-septate; basidia usually 4-celled; basidiospores broadly ellipsoid with a large, blunt apiculus, 14-22.5 x 6.5-12.5 µm. Brown cubical pocket rot of 2 in CO; 9 in AT.

1. Basidiocarps pileate, ear-like; basidia straight . . . . *Auricularia* Pers.

Auricularia auricularis (S. F. Gray) G. W. Martin. Basidiocarps grayish to brownish with a brown hymenial surface; interior hyphae thin-walled, with clamps; hyphae on abhymenial surface thick-walled, aseptate; basidia imbedded, difficult to discern; basidiospores allantoid, 13-17 x 5-6 µm. White rot of 2 in ID, UT; 3 in AT, BC, MN, NB; 6 in CT, ME, NH, NY; 9 in CO, MN.

Family DACRYMYCETACEAE

Key to genera

1. Basidiocarps pulvinate or discoid; lacking thick-walled sterile cells on lower surface . . . . *Dacrymyces* Fr.
1. Basidiocarps conical, attached by a narrow base; thick-walled sterile cells present on lower surface . . . . *Heterotextus* Lloyd

Heterotextus alpinus (Tracy et Earle) G. W. Martin. Basidiocarps bright yellowish orange, on wood buried in snow; hymenial surface concave; hyphae with clamps; basidiospores allantoid, 2-4 septate, 12-16 x 4-5 µm. On 2 in CO, ID, MT, OR, UT, WY.

Key to species of *Dacrymyces*

1. Basidiocarps cerebriform, bright orange 2
1. Basidiocarps discoid or turbinate, pale yellow to pale orange or dark reddish orange to reddish brown 3
    2. Mature basidiospores 4-celled

Dacrymyces ellisii Coker. Hyphae simple-septate; basidiospores cylindric, curved, 12-15 x 5.5-7 µm. On 9 in QB.

2. Mature basidiospores 7-9 celled

Dacrymyces palmatus (Schw.) Bres. apud Hoehn. Hyphae mostly simple-septate, infrequent clamps sometimes present; basidiospores cylindric, curved, with large, blunt apiculus, 17-22 x 5-6.5 µm. On 2 in AZ; 3 in BC; 4 in AT.

3. Basidiocarps discoid; basidiospores 1-3 celled

Dacrymyces punctiformis Neuhoff. Basidiocarps dark reddish orange to reddish brown, with a shallow central depression; hyphae mostly with clamps, some thin-walled, others thick-walled with a narrow lumen; basidiospores cylindric, curved, 11-15 x 3-4 µm. On 2 in MT.

3. Basidiocarps turbinate; basidiospores 4-9 celled

Dacrymyces abietinus (Pers.) Schroet. Basidiocarps pale yellow to pale orange; hyphae mostly with clamps; basidiospores cylindric or allantoid, 16-20 x 6-8 µm. On 2 in CO.

Family TREMELLACEAE

Key to genera

1. Basidiocarps resupinate, arid or waxy. 2
1. Basidiocarps substipitate or cerebriform, gelatinous 3
   2. Gloeocystidia absent. .*Exidiopsis* (Joh. - Ols. ex Bref.) Moll.
   2. Gloeocystidia present . . . *Bourdotia* (Bres.) Bres. et Torrend

Bourdotia eyrei (Wakef.) Bourd. et Galz. Basidiocarps light gray or light ochre-yellow to reddish brown; gloeocystidia cylindric to almost clavate or fusiform, with yellowish contents; basidiospores subglobose to globose, 4-7 µm in diam. On 5 in CO.

3. Basidiocarps laterally substipitate; hymenial surface with well developed pendent spines . . . . *Pseudohydnum* Karst.

Pseudohydnum gelatinosum (Fr.) Karst. Basidiocarps white, semitransparent or with yellowish gray to grayish brown upper surface and white spines; hyphae with clamps; basidiospores subglobose to globose, 5-7 µm in diam. On 2 in CO.

3. Basidiocarps cerebriform; hymenial surface lacking spines . . . . *Tremella* Fr.

Tremella mesenterica (S. F. Gray) Pers. Basidiocarps golden yellow to orange; hyphae with occasional clamps; basidiospores subglobose, 6-10 µm in diam. On 3 in BC.

Key to species of *Exidiopsis*

1. Basidiocarps resupinate, arid; basidiospores 15-22 x 6-9 µm.

Exidiopsis calcea (Pers.) Wells. Basidiocarps white or grayish white; hyphae with clamps; basidiospores cylindric to allantoid, 12-20 x 5-7.5 µm. White rot of 2 in AZ, MT; 3 in AK, BC, YT; 4 in MN, NS; 9 in MB, NS, PEI.

2. Basidiocarps resupinate to reflexed in drying, arid, coriaceous; basidiospores 10-15 x 5-7.5 µm.

Exidiopsis macrospora (Ell. et Everh.) Wells. Probasidia becoming obovate to subglobose, 15-22 x 8-14 µm. On 3 in BC.

Family TULASNELLACEAE

Key to species of *Tulasnella* Schroet.

1. Basidiospores subglobose

Tulasnella violea (Quél.) Bourd. et Galz. Basidiocarps thin, gelatinous, lilac to reddish gray; hyphae simple-septate; basidiospores 5-9 x 4-7 µm. On 5 in CO.

1. Basidiospores cylindric-ellipsoid

Tulasnella pruinosa Bourd. et Galz. Basidiocarps thin, cobwebby to membranous, white to pinkish lilac, occasionally with a greenish tinge; hyphae simple-septate; basidiospores 4-7 x 3-4 µm. On 2 in MT.

Family CLAVARIACEAE

Clavariadelphus Donk

Clavariadelphus ligula (Fr.) Donk. Basidiocarps occurring in groups or singly, narrowly clavate to flattened, salmon color to orange-buff, with a white, downy base; interior tissue white; basidiospores elliptical, 12-15 x 3-4.5 µm. On 2 in AZ, MT; 3 in BC.

Family CONIOPHORACEAE

Key to genera

1. Hymenophore smooth or tuberculate 2
1. Hymenophore irregularly folded or toothed . . . *Serpula* S. F. Gray

Serpula himantioides (Fr. ex Fr.) Karst. Hymenial surface meruloid, light brown to raw umber; margin cream colored; hyphae with clamps; basidiospores narrowly ellipsoid, dextrinoid in Melzer's reagent, 10-14 x 5-6 µm. Brown rot of 2 in AZ, CO; 3 in AT, BC, MB, NB, OT; 4 in OT, QB.

2. Large, septate cystidia abundant 3
2. Cystidia absent or if present, small and aseptate . . . . *Coniophora* DC. ex Mérat
3. Basidia barrel shaped to obovate . . . . *Suillosporium* Pouz.

Suillosporium cystidiatum (Rogers) Pouz. Basidiocarps whitish with a faint yellowish tinge; hyphae with clamps; cystidia cylindric, tapering to the apex; basidiospores cylindric to fusiform, slightly curved, 11-14 x 4-5 µm. On 9 in OT, QB.

3. Basidia cylindric-clavate . . . . *Coniophorella* Karst.

Coniophorella olivacea (Fr. ex Fr.) Karst. Basidiocarps olivaceous to brownish; margin whitish or concolorous; hyphae simple-septate; cystidia cylindric, coarsely incrusted; basidiospores ovate to ellipsoid, strongly dextrinoid in Melzer's reagent, 8-13 x 4-5 µm. Brown rot of 2 in CO, MT; 3 in BC; 4 in AT; 9 in AT, CO, MB, MN.

Key to species of *Coniophora*

1. Subicular hyphae simple-septate or with some single, double, or multiple clamps; basidiospores dextrinoid in Melzer's reagent 2
1. Subicular hyphae with abundant single clamps; basidiospores negative in Melzer's reagent

Coniophora corrugis Burt. Hymenial surface pale brownish, shallowly merulioid; margin whitish; basidiospores broadly ellipsoid, 7-10 x 5-7 µm. White rot of 2 in AZ, CO, ID, UT, WY; 5 in AZ.

2. Basidiospores ellipsoid, 10-16 µm long 3
2. Basidiospores fusiform, 16-22 µm long

Coniophora fusispora (Cke. et Ellis) Cke. Basidiocarps pale buff; basidiospores 16-22 x 6-7.5 µm. On 9 in NS.

3. Basidiocarps becoming thick, fleshy, readily separable from substratum

Coniophora puteana (Schum. ex Fr.) Karst. Hymenial surface olive brown; margin cream colored; some hyphae with single, double, or multiple clamps; basidiospores 11-16 x 7-9 µm. Brown rot of 2 in AT, AZ, BC, CO, MB, MT; 3 in AK, AT, BC, MB, NB, OT; 4 in AT, MB, NB, OT, QB; 9 in CO, MB.

3. Basidiocarps thin, arid, not readily separable from substratum

Coniophora arida (Fr.) Karst. Hymenial surface light brown to olive brown; margin whitish to yellowish brown; hyphae simple-septate; basidiospores 10-14 x 5-8 µm. Brown rot of 2 in AZ, CO, ID, MT; 9 in MB, QB.

Family ECHINODONTIACEAE

Key to genera

1. Basidiocarps thick, sessile, ungulate; interior tissue brick red; hymenial surface strongly hydnaceous . . *Echinodontium* Ell. et Ev.

Echinodontium tinctorium (Ell. et Ev.) Ell. et Ev. Upper surface becoming blackish, rough, and rimose; hymenial surface pale olive buff; hyphal system dimitic; generative hyphae with clamps;

basidiospores ellipsoid, minutely echinulate to smooth, 6-8 x 5-6 µm. Brownish stringy heartrot of 2 in AZ, BC, ID, MT, NM; 3 in BC; 7 in BC.

1. Basidiocarps thin, effused-reflexed to resupinate; context pinkish buff; hymenial surface tuberculate to smooth . . . *Laurilia* Pouz.

Laurilia sulcata (Burt) Pouz. Upper surface pale to dark brownish, tomentose, becoming blackish, sulcate; hymenial surface pinkish buff to ochraceous; hyphal system trimitic; generative hyphae with clamps; basidiospores subglobose to globose, amyloid, echinulate, 5-6.5 x 4.5-6 µm. White pocket rot of 2 in AT, CO, ID, MT; 3 in AK, AT, BC; 5 in CO; 9 in AT, ID.

Family HERICIACEAE

Key to genera

1. Basidiocarps coralloid, intricately branched *Hericium* Pers. ex S. F. Gray

Hericium abietis (Weir ex Hubert) K. Harrison. Basidiocarps large, densely or loosely branched from a solid tubercle, white to cream colored; spines up to 1 cm long; hyphae thick-walled, with clamps, often ampullate, amyloid in Melzer's reagent; cystidia and gloeocystidia present; basidiospores subglobose, minutely rough to smooth, 4.5-6 x 4-5 µm. White rot of 2 in ID, MT, WA; 7 in AK, BC.

1. Basidiocarps consisting of individual spines arising directly from substratum; no subiculum present . . . . *Mucronella* Fr.

Mucronella aggregata Fr. Individual spines simple or branched, cream colored to pinkish buff, up to 1.5 mm long; hyphae thin-walled, with simple septa and clamps, some swollen or contorted; basidiospores ellipsoid, smooth, 4-6 x 2.5-3.5 µm. White rot of 2 in AZ, BC, CO.

Family HYMENOCHAETACEAE

Key to genera

1. Stellately branched setal hyphae not present in basidiocarps. . 2
1. Stellately branched setal hyphae abundant in subiculum and hymenium . . . . *Asterodon* Pat.

Asterodon ferruginosus Pat. Basidiocarps resupinate, soft and cottony; hymenial surface hydnaceous, cinnamon brown to reddish brown; margin with brown rhizomorphs; basidiospores hyaline, ovoid to broadly ellipsoid, 5-7.5 x 3-4 µm. White rot of 3 in AK, BC, YT; 6 in CT, ME, NH, NY.

2. Hymenophore consisting of united tubes. 3
2. Hymenophore smooth . . . . *Hymenochaete* Lév.
3. Basidiocarps perennial. . . . . *Phellinus* Quél.
3. Basidiocarps annual . . . . *Inonotus* Karst.

Key to species of *Hymenochaete*

1. Setigerous layer next to substratum 2
1. Setigerous layer separated from substratum by a hyphal layer lacking setae 3
   2. Setae 36-45 x 5-7 µm

Hymenochaete tenuis Pk. Basidiocarps resupinate; hymenial surface smooth, cracking; basidiospores cylindric-ellipsoid, 4.5-5.5 x 2-3 µm. White rot of 3 in AK.

2. Setae 60-75 x 8-9 µm

Hymenochaete fuliginosa (Pers.) Lév. Basidiocarps resupinate; hymenial surface colliculose; basidiospores ovoid, 4-5 x 2-3 µm. White rot of 3 in BC.

3. Several setigerous layers present in subiculum

Hymenochaete cinnamomea (Pers.) Bres. Basidiocarps resupinate; setae 60-90 x 5-6 µm; basidiospores 4.5-6 x 2-2.5 µm. White rot of 3 in YT; 9 in BC.

3. Single setigerous layer present in hymenial region

Hymenochaete tabacina (Sow. ex Fr.) Lév. Basidiocarps resupinate to effused-reflexed; hymenial surface cracking radially; setae 75-100 x 7.5-10 µm; basidiospores short-cylindric, 4-4.5 x 1.5-2 µm. White rot of 2 in AT; 6 in CT, ME, NH, NY; 9 in NS.

Key to species of *Inonotus*

1. Hymenial setae hooked; pileus usually over 2 cm thick 2
1. Hymenial setae straight; pileus usually less than 1 cm thick

Inonotus tomentosus (Fr.) Gilbn. Basidiocarps circular to flabelliform, centrally to laterally stipitate, often developing in large numbers; setae 50-70 (-140) x 7-11 µm; basidiospores ellipsoid, 5-6 x 3-4 µm. White pocket root and butt rot of 2 in AZ, BC, CO, ID, OR, WA; 3 in AK, AT, BC, MB, NB, OT, SK; 4 in AT, MB, NB, OT, QB; 6 in NS; 7 in BC, OR; also pathogenic on spruce in Canada, causing a root rot called stand opening disease.

2. Setae subulate; basidiospores ellipsoid; context duplex

Inonotus circinatus (Fr.) Gilbn. Basidiocarps circular to dimidiate, usually laterally substipitate or sessile on the base of trees, sometimes centrally stipitate, usually single; setae 50-80 x 12-20 µm; basidiospores 5-6.5 x 3-4 µm. White pocket root and butt rot of 2 in AT, AZ, CO, ID, NM, UT; 3 in BC, MN, NB, OT, SK; 4 in MN, OT; 6 in NB, NS; 7 in BC; 9 in ID, NY.

2. Setae ventricose; basidiospores subglobose; context not duplex

Inonotus dryadeus (Pers. ex Fr.) Murr. Basidiocarps up to 35 cm wide and 15 cm thick, sessile at base of trees; pore surface often exuding amber colored droplets; context mottled; setae 25-40 x 9-16 μm; basidiospores dextrinoid in Melzer's reagent, 6-8 x 5-7 μm. White root and butt rot of 2 in CO, ID, MT, OR, WA; 7 in CA, WA.

Key to species of *Phellinus*

1. Setal hyphae present in tramal tissue and projecting beyond hymenium. 2
1. Setal hyphae not present in tramal tissue 3
    2. Projecting ends of setal hyphae curved; basidiospores allantoid

Phellinus ferrugineofuscus (Karst.) Bourd. Basidiocarps resupinate; pore surface purplish brown; margin yellowish brown to white; setal hyphae 5-7 μm in diam; basidiospores 4-5.5 x 1.5-2 μm. White laminated and mottled rot of 2 in AZ, CO, MT, UT; 3 in BC, OT, NWT; 9 in AT.

    2. Projecting ends of setal hyphae straight; basidiospores ovoid to subglobose

Phellinus weirii (Murr.) Gilbn. Basidiocarps resupinate; pore surface and margin yellowish brown; setal hyphae 6-10 μm in diam; basidiospores 4-5.5 x 3-4.5 μm. Yellow laminated root and butt rot of 2 in BC; 7 in BC.

3. Basidiospores cylindric, straight or allantoid 4
3. Basidiospores ellipsoid to subglobose or globose 7
    4. Setal hyphae not present in subiculum and martinal tissue. . 5
    4. Setal hyphae present in subiculum and marginal tissue

Phellinus ferruginosus (Schrad. ex Fr.) Bourd. et Galz. Basidiocarps resupinate; pores variable in size, 2-8 per mm; hymenial setae subulate, 40-150 x 6-10 mm; basidiospores 4.5-7 x 2.5-3 μm White rot of 3 in BC; 9 in AT.

5. Pores 4-7 per mm; setae not over 40 μm long 6
5. Pores 2-4 per mm; setae up to 80 μm long

Phellinus viticola (Schw.) Donk. Basidiocarps sessile, effused-reflexed, or resupinate; pilei dimidiate to elongate, up to 1.5 cm wide; setae subulate; basidiospores cylindric, straight to slightly curved, 5.5-8 x 1.5-2 μm. White rot of 2 in CO, BC, ID, MT; 3 in YT.

    6. Black lines present in context

Phellinus nigrolimitatus (Rom.) Bourd. et Galz. Basidiocarps sessile, effused-reflexed, or resupinate; upper surface soft and spongy at first; setae subulate to ventricose, 25-37 x 6.5-8.5 μm; basidiospores straight, tapering to the apex and appearing carrot shaped, 7-10 x 2-2.5 μm. Large white pocket rot of 2 in AZ, CO, ID, MT, UT; 3 in AK, BC, YT; 7 in AK, BC, OR; 9 in AK, BC.

    6. Black lines not present in context

Phellinus ferreus (Pers.) Bourd. et Galz. Basidiocarps resupinate; pore surface yellowish brown; setae subulate to slightly ventricose, 22-30 x 6-7 µm; basidiospores straight, 5-7.5 x 2-2.5 µm. White rot of 3 in BC.

7. Pores 1-4 per mm; setae abundant 8
7. Pores 4-10 per mm; setae rare 9
    8. Basidiocarps thin, usually occurring in clusters; upper surface hirsute

Phellinus chrysoloma (Fr.) Donk. Basidiocarps short-lived, sometimes annual; pilei usually less than 2 cm thick; setae subulate to ventricose, 30-60 x 10-14 µm; basidiospores ovoid to subglobose, 4.5-6 x 3.5-4.5 µm. White pocket rot of 2 in AZ, UT; 4 in AK.

    8. Basidiocarps thick, usually occurring singly under branch stubs on living trees; upper surface glabrous, crustose

Phellinus pini (Thore. ex Fr.) Pilát. Basidiocarps sessile, perennial for several years; pilei usually more than 5 cm thick on older specimens; setae subulate to ventricose, 40-50 x 10-14 µm; basidiospores ovoid, 4.5-7 x 3.5-5 µm, becoming yellowish in older specimens. White pocket trunk rot of 1 in OR; 2 in AT, BC, MB, NB, NS, OT, QB, SK, VT; 4 in AK, AT, MB, NB, NS, NWT, OT, QB, SK, YT; 5 in CO; 6 in CT, ME, NB, NC, NH, NS, NY, QB; 7 in AK, BC, CA, OR, WA; 9 in AK, MB, NB, NS, PEI.

9. Basidiospores subglobose, 5-8 µm in diam, dextrinoid in Melzer's reagent

Phellinus robustus (Karst.) Bourd. et Galz. Basidiocarps resupinate, effused-reflexed, or sessile; upper surface black and rimose with age; context bright yellowish brown; setae absent or extremely rare. White rot of 9 (listed in Overholts, 1953).

9. Basidiospores broadly ellipsoid to subglobose, 4-5.5 x 3-4.5 µm, negative in Melzer's reagent

Phellinus repandus (Overh.) Gilbn. Basidiocarps usually resupinate, rarely reflexed or sessile; pore surface grayish brown when fresh, drying reddish brown, rough to the touch; context yellowish brown, soft and spongy to corky; setae rare, subulate to ventricose, 20-25 x 6-7 µm. White pocket rot of 2 in MT.

Family LACHNOCLADIACEAE

Key to genera

1. Asterohyphidia present. . . . . *Asterostroma* Massee
1. Asterohyphidia absent, dichohyphidia or dendrohyphidia present 2
    2. Dichohyphidia present, with distinct dichotomous branching . . . . *Vararia* Karst.
    2. Dendrohyphidia present, not distinctly dichotomously branched . . . .*Scytinostroma* Donk

Key to species of *Asterostroma*

1. Basidiospores smooth; rays of asterohyphidia rarely branched

Asterostroma andinum Pat. Basidiocarps soft, byssoid to arachnoid; hyphae simple-septate; asterosetae present in subiculum and hymenium; basidiospores amyloid, globose to subglobose, 5-6 µm in diam. White rot of 9, reported by Seymour (1929).

1. Basidiospores tuberculate; rays of asterohyphidia commonly branched

Asterostroma cervicolor (Berk. et Curt.) Massee. Basidiocarps soft; hymenial surface pale brownish; hyphae simple-septate; asterosetae present in subiculum and hymenium; gloeocystidia present; basidiospores amyloid, sparsely tuberculate, globose to subglobose, 4-7 x 3-6 µm. White rot of 3 and 9, reported by Seymour (1929).

Key to species of *Scytinostroma*

1. Basidiospores echinulate, amyloid

Scytinostroma arachnoideum (Pk.) Gilbn. Basidiocarps resupinate, soft-cottony, cream color to pale buff; hymenial surface smooth to papillate or strongly hydnaceous; margin rhizomorphic; hyphae of two types, some thick-walled, aseptate, dextrinoid in Melzer's reagent; gloeocystidia cylindric or with irregular constrictions and swellings; basidiospores ovoid to subglobose, 3.5-4.5 x 2.5-3.5 µm. White rot of 2 in AZ; 6 in NH; 7 in WA.

1. Basidiospores smooth, not amyloid

Scytinostroma galactinum (Fr.) Donk. Basidiocarps resupinate, becoming widely effused; hymenial surface cream colored to pale buff, smooth to papillate; dendrohyphidia densely interwoven, strongly dextrinoid in Melzer's reagent; generative hyphae with clamps; gloeocystidia imbedded or projecting; basidiospores short-cylindric to ellipsoid, 4-5.5 x 2-2.5 µm. White rot of 2 in BC, OR, WA; 3 in BC, NB, OT; 4 in MB, NB, OT, QB; 6 in CT, ME, NH, QB; 9 in AT, NS, NY.

Key to species of *Vararia*

1. Basidiospores cylindric to fusiform, negative in Melzer's reagent. 2
1. Basidiospores ellipsoid, amyloid

Vararia granulosa (Fr.) M. Laur. Basidiocarps resupinate; hymenial surface pinkish buff to pale buff, smooth to grandinioid; dichohyphidia abundant, strongly dextrinoid; generative hyphae with clamps; gloeocystidia weakly positive in sulfuric benzaldehyde; basidiospores with darker amyloid surface granules when mature, 5-5.5 x 3-3.5 µm. White rot of 2 in BC; 3 in BC.

2. Basidiospores fusiform; dichohyphidia loosely branched;

gloeocystidia thin-walled 3

2. Basidiospores cylindric; dichohyphidia in small, densely branched clusters; cystidia thick-walled

Vararia racemosa (Burt) Rogers et Jacks. Basidiocarps resupinate; hymenial surface pale buff, smooth; dichohyphidia abundant, strongly dextrinoid; generative hyphae simple-septate; cystidia often mucronate, with the wall thinning out at the narrowed apex; basidiospores 5-7 x 2-2.5 μm. White rot on 2 in AZ, CO, MT, UT.

3. Gloeocystidia positive in sulfuric benzaldehyde; basidiospores tear shaped.

Vararia athabascensis Gilbn. Basidiocarps resupinate; hymenial surface pale ochraceous buff to pinkish buff, smooth; dichohyphidia strongly dextrinoid; generative hyphae with clamps; gloeocystidia often mammillate; basidiospores 11-16 μm long, 3-5 μm wide at the distal end. White rot on 2 in AZ.

3. Gloeocystidia negative in sulfuric benzaldehyde; basidiospores swollen in the middle and tapered to both ends, often with sterigma remaining attached

Vararia investiens (Schw.) Karst. Basidiocarps resupinate; hymenial surface light buff to bright yellow; dichohyphidia slightly to distinctly dextrinoid; generative hyphae with clamps; gloeocystidia cylindric; basidiospores 7-8.5 x 3-3.5 μm. White rot of 5 in CO; 9 in QB.

Family PUNCTULARIACEAE

Punctularia Pat.

Punctularia strigosozonata (Schw.) Talbot. Basidiocarps resupinate to effused-reflexed; upper surface dark brown; hymenial surface bright reddish purple to dark brownish purple, with folds and ridges in radiating patterns; hyphae with clamps; dendrohyphidia in hymenium; basidiospores broadly cylindric to ellipsoid, 7.5-9 x 3-4 μm. White rot of 9 in QB.

Family SPARASSIDACEAE

Sparassis Fr.

Sparassis radicata Weir. Basidiocarps annual, arising from a perennial, elongated, underground pseudosclerotium as a rounded cluster of many anastomosing and subdivided petaloid lobes with thin, wavy margins, cream colored to yellowish tan; hyphae irregularly inflated, mostly with clamps, some simple septa present; aseptate gloeoplerous hyphae present; basidiospores ellipsoid, 5-7 x 3-5 μm. Brown cubical root and butt rot of 2 in ID, MT, OR, WA. Evidently conspecific with *Sparassis crispa* Fr. of Europe (Martin and Gilbertson, 1976).

Family STECCHERINACEAE

Key to genera

1. Heavily incrusted skeletocystidia present . . . . *Steccherinum* S. F. Gray

Steccherinum ciliolatum (Berk. et Curt.) Gilbn. Basidiocarps resupinate; hymenial surface hydnaceous, white to pale buff; margin often with white rhizomorphs; generative hyphae with clamps; basidiospores short-cylindric to oblong, 3.5-5 x 2-2.5 µm. White rot of 9 in QB.

1. Cystidia lightly incrusted or not incrusted. 2

2. Vesicular cystidia present throughout subiculum . . . . *Cystostereum* Pouz.
2. Cystidia fusoid, projecting from hymenium . . . . *Fibricium* J. Erikss.

Fibricium rude (Karst.) Jülich. Basidiocarps resupinate; hymenial surface smooth, white to cream colored; generative hyphae with clamps; cystidia 55-85 x 5-7 µm, projecting to 50 µm; basidiospores short-cylindric, 4-5.5 x 2-2.5 µm. White rot of 2 in AZ; 7 in AK.

Key to species of *Cystostereum*

1. Vesicular gloeocystidia thick-walled, up to 25 µm in diam; hymenial surface coarsely tuberculate.

Cystostereum murraii (Berk. et Curt.) Pouz. Basidiocarps perennial, resupinate to effused-reflexed; upper surface becoming black, crustose; hymenial surface olivaceous buff to cinereous; generative hyphae with clamps; basidiospores cylindric-ellipsoid to ovoid, 4-5 x 2.5-3 µm. White rot of 9 in QB.

1. Vesicular gloeocystidia thin-walled, up to 10 µm in diam; hymenial surface grandinioid

Cystostereum piceinum (Overh.) Linds. et Gilbn. Basidiocarps annual, resupinate; hymenial surface gray to pinkish buff; generative hyphae with clamps; basidiospores subglobose, 3.5-4 x 3-3.5 µm. White rot of 6 in NH.

Family STEREACEAE

Key to genera

1. Hymenial surface and inner tissue of basidiocarps brown 2
1. Hymenial surface and inner tissue of basidiocarps not brown . . .4
    2. Cystidia thick-walled, not incrusted, wall thinning to apex; hymenial surface glaucous with fine, needle like crystals . . . . *Columnocystis* Pouz.
    2. Cystidia lightly to heavily incrusted, with uniformly thin or thick walls; hymenial surface not glaucous 3

3. Basidiospores amyloid in Melzer's reagent; cystidia thick-walled, heavily incrusted, 3.5-6 µm in diam . . . . . . *Amylostereum* Boid.

Amylostereum chailletii (Pers. ex Fr.) Boid. Basidiocarps resupinate to narrowly reflexed; hymenial surface light brown, smooth to tuberculate, cracking into small angular blocks; hyphal system dimitic; generative hyphae with clamps; cystidia brown, with a basal clamp; basidiospores cylindric, 6-8.5 x 2-3 µm. White rot of 2 in CO, AT, OR, WA; 3 in BC, OT, AK; 4 in QB; 6 in NS, NB; 7 in BC; 9 in AT, NY, WA.

3. Basidiospores negative in Melzer's reagent; cystidia thin-walled, lightly incrusted, 2-4 µm in diam . . . . *Boreostereum* Parm.

Boreostereum radiatum (Pk.) Parm. Basidiocarps resupinate to effused-reflexed; hymenial surface rusty brown, often turning blackish, with radially arranged ridges; hyphal system dimitic; generative hyphae simple-septate; basidiospores cylindric, 7.5-10 x 3-3.5 µm. White rot of 3 in MN; 4 in BC, MN; 9 in ID, MT.

4. Basidiospores negative in Melzer's reagent; hymenial surface of fresh specimens not staining red 5
4. Basidiospores amyloid in Melzer's reagent; hymenial surface of fresh specimens bruising red . . . . . *Haematostereum* Pouz.

Haematostereum sanguinolentum (Alb. et Schw. ex Fr.) Pouz. Basidiospores resupinate to effused-reflexed; upper surface tomentose, buff to gray; hymenial surface smooth, light buff to purplish gray; vesicular hyphae and pseudocystidia with brownish, granular contents; generative hyphae simple-septate; basidiospores cylindric, usually 5-8 x 2-3 µm but in some specimens with 2-sterigmate basidia 8-14 x 3-5 µm. White rot of 2 in AZ, CO, OR, WA; 3 in AK, AT, BC, MB, NB, NS, OT, YT; 4 in MB, NB, OT, QB; 6 in CT, ME, NB, NH, NS, NY, QB; 7 in AK, BC; 9 in MB, NB, NS, PEI.

5. Cystidia globose, thin-walled, present in context and hymenium . . . . *Chondrostereum* Pouz.

Chondrostereum purpureum (Pers. ex Fr.) Pouz. Basidiocarps resupinate to effused-reflexed; upper surface tomentose, light to dark buff; hymenial surface violaceous buff to reddish purple, smooth to tuberculate; hyphal system dimitic; generative hyphae with clamps; cystidia up to 20 µm in diam; basidiospores cylindric, 6-8 x 2.5-3 µm. White rot of 3 in BC.

5. Cystidia fusoid, thick-walled with wall thinning at apex, in hymenium only. . . . . . *Stereum* Pers. ex S. F. Gray emend. Pouz.

Stereum hirsutum (Fr.) S. F. Gray. Basidiocarps resupinate to effused-reflexed; upper surface hirsute, gray to buff; hymenial surface orange-buff to cinereous, smooth; hyphal system dimitic; generative hyphae simple-septate; cystidia up to 6 µm in diam; basidiospores cylindric, 5-8 x 2-3.5 µm. White rot of 7 in AK.

Key to species of *Columnocystis*

1. Generative hyphae with clamps; cystidia not incrusted

Columnocystis abietina (Pers. ex Fr.) Pouz. Basidiocarps resupinate to effused-reflexed or sessile; upper surface tomentose, pale to dark brown; hymenial surface grayish brown, smooth; cystidia 85-120 x 8-9 µm; basidiospores cylindric, 10-15 x 4-5.5 µm. Brown cubical pocket rot of 2 in AK, CO, UT, WY; 3 in AK, YT; 4 in AK, NY; 7 in AK, BC; 9 in NY, OR.

1. Generative hyphae simple-septate; cystidia lightly incrusted

Columnocystis ambigua (Pk.) Pouz. Basidiocarps resupinate to effused-reflexed; upper surface tomentose, dark brown; hymenial surface grayish brown to dark reddish brown, smooth; cystidia 150-250 x 8-14 µm; basidiospores cylindric, 12-16 x 3.5-4 µm. Brown cubical rot of 6 in ME, NC; 9 in NC, NY, TN.

Family THELEPHORACEAE

Key to genera

1. Basidiocarps entirely resupinate 2
1. Basidiocarps becoming pileate . . . . *Thelephora* Fr.

Thelephora terrestris Ehrh. ex Fr. Basidiocarps effused-reflexed or caespitose with imbricate pilei; hymenial surface grayish brown; hyphae of two types, some contorted and irregular, others uniform in diam, with clamps and simple septa; basidiospores brown, coarsely warted, subglobose to irregular, 6-9 x 5-8 µm. On 2 in ID; 4 in MN; 9 in PA.

2. Cystidia if present not thick-walled and septate; hyphal system monomitic or dimitic 3
2. Cystidia thick-walled, septate, in fascicles; hyphal system dimitic . . . . *Tomentellina* Hoehn. et Litsch.

Tomentellina fibrosa (Berk. et Curt.) M. J. Larsen. Hymenial surface ferrugineus, smooth to hydnaceous; generative hyphae simple-septate; cordons present; cystidia 4-7 µm in diam and projecting to 100 µm; basidiospores globose, brown, warted, with warts sometimes bifurcate, 7-9 µm in diam. On 3 in AK, YT.

3. Subicular hyphae simple-septate, dark colored; basidiocarps often incrusting organic debris and plant parts and approaching a terrestrial habit; fruiting surface often becoming negatively geotropic. . . . .*Tomentellastrum* Svrček

Tomentellastrum floridanum (Ell. et Ev.) M. J. Larsen. Hymenial surface dark purplish brown or reddish brown, smooth; basidiospores globose to subglobose, pale brownish, echinulate to aculeolate, 8.5-10 µm in diam. On 3 in YT.

3. Not with the above combination of characters 4
4. Subicular hyphae simple-septate or with clamps; young basidia

napiform; basidiospores with coarse, often bifurcate warts . . . . *Pseudotomentella* Svrček
4. Subicular hyphae with clamps or simple-septate; young basidia clavate, basidiospores mostly echinulate, rarely with bifurcate warts . . . . *Tomentella* Pat.

Key to species of *Pseudotomentella*

1. Subicular hyphae simple-septate, clamps lacking 2
1. Subicular hyphae with clamp connections and some simple septa

Pseudotomentella humicola M. J. Larsen. Hymenial surface ferrugineus to pale brown, crustose to pelliculose, smooth; tissue black in KOH; hyphal system monomitic; basidiospores globose to irregular, pale yellowish, 6-9 μm in diam. On 4 in OT.

2. Basidiospores pale yellowish to hyaline; hyphal system dimitic 3
2. Basidiospores brownish; hyphal system monomitic

Pseudotomentella umbrina (Fr.) M. J. Larsen. Basidiocarps becoming widely effused, usually becoming crustose; fertile areas discontinuous at first, dark brown to blackish purple; basidiospores globose, 7-9 μm in diam. On 6 in NY.

3. Subiculum dark blue or violaceous black

Pseudotomentella nigra (Hoehn. et Litsch.) Svrček. Basidiocarps curling away from substratum at edges; fertile areas continuous, forming a distinct pellicle over the subiculum; cordons present; basidiospores globose to irregular, 8-12 μm in diam. On 9 in CO.

3. Subiculum pale brown

Pseudotomentella mucidula (Karst.) Svrček. Basidiocarps with hymenial surface tomentose, rarely pelliculose; fertile areas pale lavender brown to tan; cordons present; basidiospores globose, 8-12 μm in diam. On 9 in WA.

Key to species of *Tomentella*

1. Hyphal system monomitic 2
1. Hyphal system dimitic

Tomentella calcicola (Bourd. et Galz.) M. J. Larsen. Basidiocarps tawny to dark brown; hymenial surface smooth to hydnaceous; generative hyphae yellowish brown, mostly with clamps, some simple-septate; cordons present, composed of generative hyphae; basidiospores globose to subglobose, verrucose, 5-6 μm in diam. On 9 in AT.

2. Basidiospores echinulate or aculeate, usually larger than 4-6 μm in diam 3
2. Basidiospores globose, aculeolate, 4-6 μm in diam

Tomentella chlorina (Massee) G. H. Cunn. Basidiocarps soft and fragile, arachnoid; hymenial surface yellowish green, smooth to hydnaceous; hyphae with clamps; cordons present; basidiospores purplish in KOH, slightly amyloid in Melzer's reagent. On 2 in AZ.

3. Basidia up to 20 µm in diam, narrowed sharply below 4
3. Basidia not as above 5
    4. Basidiospores 5-6.5 µm in diam; fertile areas dark brown to purplish brown

Tomentella terrestris (Berk. et Curt.) M. J. Larsen. Basidiocarps adherent, compact, up to 0.5 mm thick; hyphae with clamps and abundant clavate to pyriform vesicles up to 20 µm in diam; cordons present, infrequent; basidiospores irregular to subglobose, echinulate. On 2 in MT.

    4. Basidiospores 7-10 µm in diam; fertile areas pale yellowish brown

Tomentella nitellina Bourd. et Galz. Hymenial surface minutely punctate or granulose; hyphae mostly with clamps, some with simple septa; basidiospores pale brown, irregularly globose, echinulate. On 7 in WA.

5. Basidiocarps adherent; hymenial surface granulose to colliculose; cordons infrequent to absent; subicular hyphae mostly less than 5 µm in diam, thin-walled, not heavily pigmented 6
5. Basidiocarps not with combination of characters as above . . . 7
    6. Hymenial surface vinaceous brown; basidiospores distinctly lobed

Tomentella subvinosa (Burt) Bourd. et Galz. Basidiocarps becoming hypochnoid; hyphae with clamps; cordons rare; basidiospores 3-4 lobed, echinulate, 6-8 µm in diam. On 2 in AZ.

    6. Hymenial surface bright to dull reddish cinnamon; basidiospores globose to irregularly globose, rarely distinctly lobed

Tomentella lateritia Pat. Basidiocarps consisting of small coalescing patches; hymenial surface smooth to granulose; hyphae with clamps; globose to pyriform vesicles present in subhymenial region; basidiospores 6-8 µm in diam. On 9 in CO.

7. Basidiocarps arachnoid to byssoid, usually separable; cordons forming a conspicuous part of the subiculum 8
7. Basidiocarps not with combination of characters given above. . 10
    8. Hymenial surface normally reddish purple or rusty brown; margin honey colored to golden brown 9
    8. Hymenial surface gray to pale buff; margin whitish

Tomentella cinerascens (Karst.) Hoehn. et Litsch. Tissue blackish in KOH; hymenial surface colliculose; hyphae mostly with clamps, some simple septa present; basidiospores subglobose to globose, aculeolate to echinulate, 5-6.5 µm in diam. On 9 in MT.

9. Hymenial surface reddish purple; basidiospores pale tan to subhyaline in KOH

Tomentella atrorubra (Pk.) Bourd. et Galz. Basidiocarps turning dark bluish green or green in KOH; hyphae with clamps and some simple septa; basidiospores 4-lobed to irregular or becoming subglobose, echinulate, 6-8 µm in diam. On 9 in NY.

9. Hymenial surface red to rusty brown; basidiospores yellow to pale brown in KOH

Tomentella rubiginosa (Bres.) R. Maire. Hymenial surface granulose to colliculose; hyphae with clamps and some simple septa; dark brown cordons abundant; basidiospores irregular to lobed, echinulate, 6-9 µm in diam. On 3 in MB.

10. Basidiospores normally globose to subglobose, sometimes irregular or lobed; hyphae medium to dark brown or olive brown; hymenial surface some shade of brown or red . . . 11
10. Basidiospores frequently elongated along one axis, sometimes subglobose; hyphae pale to medium brown; hymenial surface some shade of gray, brown, or green 15

11. Hymenial surface some shade of red or orange

Tomentella bryophila (Pers.) M. J. Larsen. Hyphae with clamps, with frequent right angle branching, 6-10 µm in diam; basidiospores globose to subglobose, aculeate, 7-11 µm in diam. On 2 in AZ; 9 in MB.

11. Hymenial surface not some shade of red or orange 12
12. Subicular hyphae not incrusted or spinulose 13
12. Subicular hyphae incrusted, frequently appearing spinulose

Tomentella violaceofusca (Sacc.) M. J. Larsen. Hymenial surface grayish brown to darker brown, smooth to granulose or colliculose; hyphae with clamps, some thick-walled; basidiospores aculeate to echinulate, 6.5 µm in diam. On 3 in MN; 9 in MB.

13. Walls of subicular and subhymenial hyphae not swelling conspicuously in 10% KOH 14
13. Walls of subicular and subhymenial hyphae swelling conspicuously in 10% KOH

Tomentella ruttneri Litsch. Hymenial surface dark brown, smooth to finely punctate; hyphae with clamps, some becoming thick-walled in subiculum; basidiospores aculeate to echinulate, 7-11 µm in diam. On 9 in NY, MI.

14. Basidiospores usually 10-12 µm in diam

Tomentella bresadolae (Brinkm. in Bres.) Bourd. et Galz. Hymenial surface pale brown, smooth to finely granulose; hyphae with clamps; basidiospores globose, strongly aculeate. On 9 in NY.

14. Basidiospores usually 7-9 µm in diam

Tomentella ramosissima (Berk. et Curt.) Wakef. Hymenial surface dark brown to blackish brown; hyphae with clamps; basidiospores mostly irregular, rarely subglobose, aculeate to echinulate. On 2 in MT; 4 in NF; 9 in NF, OT, QB.

15. Hymenial surface medium to dark brown, gray, or green 16
15. Hymenial surface avellaneous, pale tan or buff

Tomentella avellanea (Burt) Bourd. et Galz. Basidiocarps sometimes cracking and becoming deeply fissured; small and inconspicuous cordons present; hyphae with clamps and some simple septa; basidiospores echinulate, 7-10 x 5-6 µm. On 9 in WA.

16. Hymenial surface some shade of brown 17
16. Hymenial surface green to olive brown

Tomentella olivascens (Berk. et Curt.) Bourd. et Galz. Basidiocarps occurring in small patches or becoming confluent and widely effused; hyphae with clamps, some thick-walled; basidiospores irregularly globose, echinulate to aculeate, 7-9 µm in diam. On 9 in NY.

17. Cordons usually present and conspicuous

Tomentella ochracea (Sacc.) M. J. Larsen. Hymenial surface vinaceous brown to buff, smooth; hyphae with clamps, often ampullate; some hyphae and basidia greenish in KOH; basidiospores subglobose or elongated, aculeolate to echinulate, 7-9 µm wide. On 2 in AZ; 9 in AZ, NJ, NY.

17. Cordons absent

Tomentella sublilacina (Ell. et Holw.) Wakef. Hymenial surface vinaceous brown to wood brown, smooth; hyphae with clamps, some ampullate, others becoming thick-walled; basidia and sterigmata often with transverse septa; basidiospores irregularly globose to lobed, echinulate, 7.5 µm wide. On 4 in NF; 9 in MI, NY, OT.

Order Agaricales

Key to Families

1. Spore print white, cream colored, or vinaceous . TRICHOLOMATACEAE
1. Spore print pink to dark purplish brown 2
    2. Spore print salmon to pink . . . . VOLVARIACEAE
    2. Spore print some shade of brown 3
3. Spore print yellowish brown to rusty brown . . . . CORTINARIACEAE
3. Spore print dark purplish brown . . . . .STROPHARIACEAE

Family CORTINARIACEAE

Key to Genera

1. Basidiocarps centrally to eccentrically stipitate . . . . *Pholiota* (Fr.) Kummer
1. Basidiocarps sessile . . . . *Crepidotus* (Fr.) Staude

Crepidotus ramosus Hesler et A. H. Smith. Basidiocarps 8-15 mm broad; upper surface buff; gills brown; cheilocystidia irregularly branched or contorted; basidiospores ellipsoid to subovoid, punctate-echinulate, 6.5-8 x 5.5-6 µm. On 9 in CO.

Key to species of *Pholiota*

1. Pileus surface viscid to glutinous. 2
1. Pileus surface not viscid 5
    2. Pileus surface bright yellow or orange 3
    2. Pileus surface pale brown to ferruginous. 4
3. Basidiospores 7-9.5 x 4.5-6 µm

Pholiota aurivella (Fr.) Kummer. Pileus surface scaly; stipe scaly; pleurocystidia thin-walled, fusoid, some lobet at apex; basidiospores slightly dextrinoid in Melzer's reagent. White rot of 2 and 3 in BC.

3. Basidiospores 6-7.5 x 4-5 µm

Pholiota limonella (Pk.) Sacc. Pileus surface scaly; stipe scaly; pleurocystidia thin-walled, clavate; basidiospores negative in Melzer's reagent. White rot of 9 in BC.

    4. Pileus surface pale brown, some pleurocystidia thick-walled at apex; chrysocystidia absent.

Pholiota decorata (Murr.) A. H. Smith et Hesler. Pileus surface fibrillose to scaly; stipe scaly; basidiospores 6-9 x 3.5-4.5 µm, negative in Melzer's reagent. White rot of 2 in AZ.

    4. Pileus surface ferruginous brown; pleurocystidia thin-walled; chrysocystidia present.

Pholiota adiposa (Fr.) Kummer. Pileus surface with concentric scales; stipe viscid, scaly; basidiospores 5-6 x 3-4 µm, negative in Melzer's reagent. White rot of 2 in BC, CO; 3 in BC.

5. Pleurocystidia and cheilocystidia present.

Pholiota bakerensis A. H. Smith et Hesler. Pileus surface fibrillose; pleurocystidia abundant, with slightly thickened walls at base, ventricose; basidiospores 7-9 x 4-5 µm, negative in Melzer's reagent. White rot of 2 in AZ.

5. Pleurocystidia absent, cheilocystidia present.

Pholiota alnicola (Fr.) Singer. Pileus surface fibrillose to scaly; stipe fibrillose; basidiospores 8-10 x 4-5.5 µm, slightly dextrinoid in Melzer's reagent. White rot of 3 in AT, BC, MB; 4 in OT; 9 in SK.

Family TRICHOLOMATACEAE

Key to genera

1. Lamellae with serrate edges. 2
1. Lamellae with edges not serrate. 3
   2. Basidiospores echinulate, amyloid in Melzer's reagent . . . . *Lentinellus* Karst.
   2. Basidiospores smooth, negative in Melzer's reagent . . . . *Lentinus* Fr.
3. Basidiocarps sessile. 4
3. Basidiocarps stipitate to substipitate to subsessile with a narrowed base. 5
   4. Lamellae not split lengthwise . . . . *Panellus* Karst.
   4. Lamellae split lengthwise, edges curled back . . . . *Schizophyllum* Fr.

Schizophyllum commune Fr. Pileus surface tomentose, grayish-white; hyphae with clamps; cystidia lacking; basidiospores cylindric, negative in Melzer's reagent. 7-11 x 2.5-3.5 µm. White rot of 3 in NB; 6 in CT, ME, NH, NS, NY; 9 in NS, PA, PEI.

5. Basidiocarps centrally stipitate. 6
5. Basidiocarps eccentrically or laterally stipitate or substipitate . . . . *Pleurotus* (Fr.) Kummer

Pleurotus ostreatus Jacq. ex Fr. Basidiocarps centrally to laterally substipitate to almost sessile; pileus surface dull tan to mousy gray, glabrous; gills decurrent; hyphae with clamps; cystidia none; basidiospores cylindric, negative in Melzer's reagent, 6-10 x 3-4 µm, spore print cream colored. White rot of 3 in BC; 4 in NWT; 9 in CO.

   6. Basidiospores not amyloid; basidiocarps typically larger than 2 cm wide. 7
   6. Basidiospores amyloid; basidiocarps small, up to 2 cm wide . . . . *Xeromphalina* Kühner et Maire

Xeromphalina campanella (Batsch ex Fr.) Kühner et Maire. Basidiocarps in dense clusters; pileus surface yellowish brown; gills decurrent; stipe dark brown, horny; pleurocystidia thin-walled, ventricose; basidiospores ellipsoid, smooth, 6.5-8 x 3.5-4 µm. On well rotted stumps and logs of 2 in AT, CO; 3 in AT, BC, NB, OT; 4 in AT, OT, QB; 6 in NB, NS; 7 in BC.

7. Basidiocarps caespitose or in dense clusters. 8
7. Basidiocarps occurring singly or in small groups . . . . *Tricholomopsis* Sing.
   8. Annulus absent; pileus surface moist to viscid, stipe not fibrillose or scaly. .9
   8. Annulus present; pileus surface fibrillose-scaly; stipe fibrillose to scaly . . . . *Armillariella* Karst.

Armillariella mellea (Vahl ex Fr.) Karst. Basidiocarps honey-brown, upper surface not viscid; gills decurrent; cystidia none; basidiospores ellipsoid, 7-13 x 4.5-7 µm. White root and butt rot of 2 in AT, AZ, CO, NM, UT; 3 in AT, BC, MB, OT, SK, NB; 4 in OT, 5 in MB; 6 in CT, ME, NB, NH, NS, NY; 7 in BC, OR, WA; 9 in AZ, CO, NB, NM, WA.

9. Stipe dark brown, velvety . . . . *Flammulina* Karst.

Flammulina velutipes (Curt. ex Fr.) Sing. Pileus surface buff to orange-brown; gills adnexed; pilocystidia and caulocystidia present; basidiospores ellipsoid, 7-8 x 3-4 µm. White rot of 2 in CO.

9. Stipe reddish brown, not velvety; pileus surface moist, glabrous, not viscid . . . .*Collybia* Fr. Kummer

Collybia acervata (Fr.) Kummer. Basidiocarps caespitose; pileus surface glabrous, pale chestnut brown; gills adnexed; basidiospores ellipsoid, 5-7 x 2-3 µm. White rot of 3 in BC.

Key to species of *Lentinellus*

1. Basidiocarps sessile; single or in umbricate clusters; pleurocystidia fusiform, 26-39 x 5-7 µm.

Lentinellus montanus O. K. Miller. Basidiocarps developing on logs in or near snow; pileus surface woolly; tramal tissue nonamyloid; basidiospores ovoid to subglobose, 4.5-6.5 x 4.5 µm. White rot of 2 in CO.

1. Basidiocarps centrally to eccentrically stipitate, usually caespitose; pleurocystidia fusiform, 30-50 x 6-8 µm.

Lentinellus omphalodes (Fr.) Karst. Pileus surface glabrous; tramal tissue nonamyloid; basidiospores ellipsoid to subglobose, 5-7.5 x 4-5 µm. White rot reported on 2 by Miller and Stewart (1971).

Key to species of *Lentinus*

1. Pileus surface becoming glabrous, pinkish-buff to dull tan; gills finely serrate, veil absent.

Lentinus kauffmanii A. H. Smith. Basidiocarps centrally to laterally stipitate; pleurocystidia abundant, cylindric to ventricose, 60-100 x 7-12 µm; basidiospores cylindric to slightly curved, 5-6 x 2-2 µm. Brown cubical pocket rot of 7 in AK, BC, CA, OR, WA.

1. Pileus surface cream to buff with darker scales; gills coarsely serrate, veil present at first.

Lentinus lepideus Fr. Basidiocarps centrally to laterally stipitate; pleurocystidia fusoid, not projecting, 40-60 x 3-5 µm; basidiospores cylindric, 9-11 x 3.35 µm. Brown cubical rot of 2 in AZ; 6 in CT, ME, NH, and NY.

Key to species of *Panellus*

1. Basidiocarps eccentrically to laterally stipitate; pileus surface

tan, pubescent.

Panellus stipticus (Bull. ex Fr.) Karst. Gills luminescent; pleurocystidia fusiform to bifurcate, 20-40 x 3-4.5 µm, basidiospores ellipsoid or slightly curved, smooth, amyloid in Melzer's reagent. White rot of 6 in CT, ME, NH, NY.

1. Basidiocarps sessile; pileus surface viscid, brown to greenish or olivaceous.

Panellus serotinus (Pers. ex Fr.) Kühner. Pleurocystidia abundant, fusiform to clavate, 35-65 x 6-11 µm; elongated, clavate pileocystidia in cuticle; basidiospores cylindric to allantoid, amyloid in Melzer's reagent, 4-5.5 x 1-5 µm. White rot of 3 in BC.

Key to species of *Tricholomopsis*

1. Pileus surface yellow with yellow or grayish scales. 2
1. Pileus surface with purplish red scales.

Tricholomopsis rutilans (Fr.) Singer. Basidiocarps up to 15 µm wide; gills yellow; stipe with red fibrils; pleurocystidia 35-60 x 6-9 µm; cheilocystidia abundant; basidiospores ellipsoid, 8-10 x 6-7 µm. White rot of 7 in AK; 9 in NH.

2. Pileus surface with grayish scales; stipe with grayish fibrils; gills yellow.

Tricholomopsis decora (Fr.) Singer. Basidiocarps up to 8 cm wide; pleurocystidia rare, barely projecting, 30-40 x 5-8 µm; basidiospores ellipsoid, 6-7.5 x 4.5-5 µm. White rot of 3 in BC.

2. Pileus surface and stipe bright yellow; gills pinkish.

Tricholomopsis streetsii Gilbertson. Basidiocarps mostly 1-2.5 cm wide; hyphae of surface tomentum thick-walled, closely nodose-septate; pleurocystidia abundant, narrowly clavate with a capitate apex, 90-125 x 10-13 µm; basidiospores lemon-shaped, 10.5-12.5 x 8-9 µm. White rot of 2 in AZ.

Family STROPHARIACEAE

Naematoloma Karst.

Naematoloma capnoides (Fr.) Karst. Basidiocarps centrally stipitate, caespitose or gregarious; upper surface of pileus pale reddish orange to cinnamon; gills grayish-white at first, becoming purplish-brown, adnate; pleurocystidia clavate, usually mucronate, contents highly refractive in KOH; basidiospores ellipsoid, yellowish-brown in KOH, appearing truncate due to apical pore, 6-7.5 x 3.5-4.5 µm. White rot of 3 in BC.

Family VOLVARIACEAE

Pluteus Fr.

Pluteus cervinus (Fr.) Quél. Basidiocarps centrally stipitate, usually single; upper surface of pileus pinkish-brown to gray; gills pinkish, free; annulus lacking; pleurocystidia abundant, with 1-4 apical horn-like projections; basidiospores ellipsoid, hyaline, pinkish-brown in mass, 7-9 x 5-6 m. White rot of 2 in AZ.

ACKNOWLEDGMENTS

This work was supported by McIntire-Stennis funds in the University of Arizona Agricultural Experiment Station. Field work by Gilbertson in spruce forests of the Southwest in 1968 and in Alaska and Yukon Territory in 1969 was supported by NSF grant no. GB7120.

LITERATURE CITED

Martin, K. J. and R. L. Gilbertson. 1977. Synopsis of wood-rotting fungi on spruce in North America: I. Mycotaxon 6(1):43-77.

Martin, K. J. and R. L. Gilbertson. 1978. Decay of Douglas-Fir by *Sparassis radicata* in Arizona. Phytopathology 68:149-154.

Martin, K. J. and R. L. Gilbertson. 1978. Synopsis of wood-rotting fungi on spruce in North America: II. Mycotaxon 7(2):337-356.

Miller, O. K., Jr. and L. Stewart. 1971. The genus *Lentinellus*. Mycologia 63:333-369.

Overholts, L. O. 1953. The Polyporaceae of the United States, Alaska, and Canada. University of Michigan Press, Ann Arbor. 466 p.

Seymour, A. B. 1929. Host index of the fungi of North America. Harvard Univ. Press, Cambridge, Mass. 718 p.

MYCOTAXON

Vol. 10. No. 2, p. 502 January-March 1980

NOTICES

SECOND INTERNATIONAL CONGRESS OF SYSTEMATIC AND EVOLUTIONARY BIOLOGY

This congress will be held in Vancouver, British Columbia, Canada from July 17 to July 24, 1980. Information may be obtained from Dr. G.G.E. Scudder, Chairman, Local Organizing Committee ICSEB-II, Department of Zoology, University of British Columbia, Vancouver, B.C. Canada V6T 1W5.

XIII INTERNATIONAL BOTANICAL CONGRESS

The First Circular, dated July, 1979, has been distributed to all botanists who have indicated an interest in attending the Thirteenth International Botanical Congress to be held in Sydney, Australia. The Nomenclature Section will meet August 17-20, 1981, prior to regular sessions. Other sections will meet August 21-28, 1981. Both pre-Congress and post-Congress field trips are announced. For further information contact Dr. W. J. Cram, Executive Secretary, 13th International Biological Congress, University of Sydney, N.S.W. 2006, Australia.

BOTANICAL LATIN

Botanical descriptions or diagnoses of new taxa will be rendered into Latin by a Latinist-botanist for a small fee. Contact P. M. Eckel, 43 Crescent Avenue, Buffalo, NY 14214 USA.

MYCOTAXON

Vol. X, No. 2, pp. 503-512 January-March 1980

REVISIONARY STUDIES IN THE HYALOSCYPHEAE.

I. ON GENERA WITH "GLASSY" HAIRS

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ABSTRACT

The "glassy-haired" members of the Hyaloscypheae (Discomycetes: Helotiales, Hyaloscyphaceae) all have either solid, refractive apices to the hairs, or thick-walled hairs with a fine lumen extending to or nearly to the apex. The glassy character derives from at least two substances: (1) glassiness disappears following aqueous KOH pretreatment, (2) glassiness retained after KOH exposure. For group (1) the generic name _Urceolella_ Boud. is accepted, and two subgenera are recognized, _U._ subg. _Urceolella_ and _U._ subg. **Hyalacrotes** subg. nov. Two genera are accepted in group (2): _Mollisina_ Höhn. for species with delicate, branched, solid excipular "processes," and _Hyalopeziza_ Fuckel, in a greatly modified sense. This genus is now conceived as containing four subgenera, the type subgenus, _Hyalopeziza_ subg. _Hyalopeziza_, and three subgenera based on previously recognized generic names: _Unguicularia_ Höhn., _Unguiculariopsis_ Rehm, and _Unguiculella_ Höhn. In two of these subgenera the hair walls give a reddish-brown (dextrinoid) reaction in Melzer's Reagent in some species, but not in others.

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In the process of studying a series of Inoperculate Discomycetes collected in Greenland by Dr. Peter Milan Petersen, of Copenhagen University, the senior author encountered a tiny, sessile, clear-yellow (when dry) species on a twig of *Salix* sp. (host identification by Hans Tybjerg and Jette Dahl Møller, Copenhagen University), which proved to be a rarely collected species, *Unguiculella* *rehmii* E. Müller (= *Mollisia* *hamulata* Rehm), known previously primarily from alpine sites on herbaceous stems. The swollen, solid, "glassy" apices of both hairs and paraphyses are provided with more or less tubular, mostly hooked or crisped, delicate "processes," much longer on the hairs than on the paraphyses (FIG. 1). Three previously unreported characteristics of the species caught our attention: (1) the glassiness of the thickened apices and "processes" of both the excipular hairs and paraphyses was lost if the material was pretreated in 10% aqueous KOH, (2) the ascus pore did not blue in Melzer's Reagent without KOH-pretreatment [previously discussed in other Ascomycetes (Kohn & Korf 1975; Nannfeldt 1976)], and (3) some of the paraphyses are typically filiform, thus lacking the thickened apices and the tubular hooks that led von Höhnel [1918, as *U. hamulata* (Rehm) Höhn., a later homonym of the type species], Müller (1968) and Raitviir (1970) to place the species in *Unguiculella*. We have begun a monographic reinvestigation of that genus, together with a study of several other, apparently closely related, genera.

KOH-PRETREATMENT AND "GLASSINESS"

Glassiness in the hairs of members of the family Hyaloscyphaceae, tribe Hyaloscypheae, has been a generic characteristic recognized by Dennis (1949, 1960, 1968, 1978) for *Unguicularia*, *Hyalotricha*, *Urceolella*, and *Hyalopeziza*, by Raitviir (1970) in *Hyalopeziza* and *Unguiculella*, and by Korf (1973) in *Urceolella* and *Unguiculariopsis*. None of these treatments can be said to be at all exhaustive, though Raitviir's much broadened concept of *Hyalopeziza* provided a major advance. A particularly important paper dealing primarily with the glassy-haired genera and species has been published only recently (Raschle 1977). Three glassy-haired genera are scarcely more than mentioned in his key (*Mollisina*, *Unguiculella*, and *Unguiculariopsis*), but three are treated in depth (*Hyalopeziza*, *Unguicularia*, and *Urceolella*). Until we studied his paper

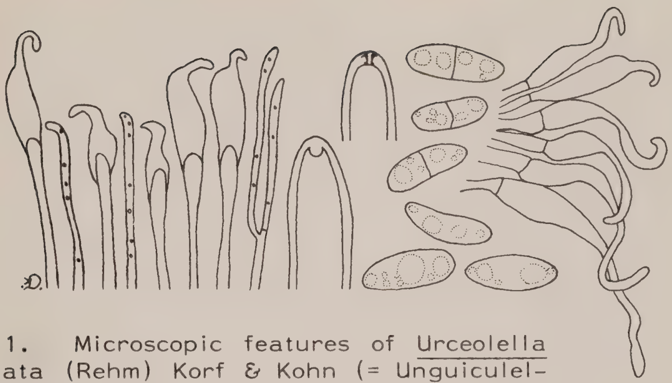

FIG. 1. Microscopic features of *Urceolella hamulata* (Rehm) Korf & Kohn (= *Unguiculella rehmii* E. Müller) x 1000. Apices of 8 paraphyses, 5 with glassy apical thickening and tubular "processes;" 2 ascus apices mounted in Melzer's Reagent, lower from water rehydrated section, upper from 10% aqueous KOH rehydrated section; 6 ascospores; 6 hairs with glassy apices and tubular "processes" from apothecial flanks. CUP **59475**. Drawn by R.P.K.

we were unaware that Raschle had earlier noted and emphasized the loss of glassiness in KOH-pretreated material. He reported it, and used it as a generic character, for only one genus, *Urceolella*. Our studies have confirmed his observations and confirmed the usefulness of this character in delimiting an apparently natural taxon.

Presence of refractive, uncinate paraphyses, similar to those of the excipular hairs, was von Höhnel's (1906) primary criterion for segregating *Unguiculella* Höhn. from *Unguicularia* Höhnel (1905). Some of the species von Höhnel transferred to his new genus lack description of such paraphysis apices, however, as noted by Raschle (1977); other authors (Bøhler 1974; Dennis 1950, 1955; Svrček 1978) have also added species without hooked paraphysis apices. Our studies on *Unguiculella* show that the type species of the genus, *U. hamulata* (Feltg.) Höhn., and most others do not lose glassiness of the hairs or paraphyses after KOH-pretreatment. This is in contrast to the situation in *U. rehmii* and in an as yet unpublished new species referred to the genus (Arendholz 1979) which we have had the opportunity to examine. Of far greater impor- than the presence of hooked paraphysis apices, to our mind, in indicating affinities is the chemistry of the substance giving rise to glassiness in the hairs, resulting here in its loss following KOH-pretreatment. Urceolella is the only genus in which we know of such a reaction, though none of its species have the solid hair apices and hooked "processes" of Unguiculella rehmii.

Moreover, we are unimpressed with such single characters as hairs being or not being hooked apically as appropriate bases to distinguish genera in the Hyaloscyphaceae. Such uncinate hair ends occur in several genera, some with glassy hairs, others without. In consequence, we have decided to place Unguiculella rehmii in Urceolella, creating for it a new subgenus, Urceolella subg. Hyalacrotes. At least one other species [Arendholz's (1979) unpublished one mentioned above] can be referred to the new subgenus. In Urceolella subg. Urceolella the hairs are not solid apically, but are thick-walled with a fine lumen that often expands again near the tip to form a thin-walled apex, and the two subgenera should be easily distinguished.

The manner in which glassiness develops in the hairs of this group of the Hyaloscyphaceae has never been adequately studied. Raschle (1977: 180) has noted that in Hyalopeziza millepunctata (Lib.) Raitv. [as Unguicularia millepunctata (Lib.) Dennis] one finds young apothecia with "hyphigen Haaren, an denen erst an der Haarspitze eine kleine, glasartige Kappe gebildet ist." We are able to confirm his observations that the hair thickening proceeds from the apex backwards in that species and in several others (at least one of which is undescribed, from our Macaronesian collections). The hairs are thin-walled when young, and at maturity there is cell lumen visible only at the very base. The glassiness thus appears to consist of secondary wall thickening.

We have not been able to confirm that a similar ontogeny accounts for the glassy "processes" found in Mollisina rubi Höhn., the type species of Mollisina Höhnel (1926). If so, these "processes" should better be considered branched, true "hairs" with the lumen completely replaced by secondary wall thickening; such an interpretation is wholly consistent with our studies, but may have to be resolved by use of the electron microscope.

REACTIONS IN MELZER'S REAGENT

In some species referred by Raschle (1977) to *Hyalopeziza* and to *Unguicularia*, but not in others, the hair walls and/or contents give a dextrinoid reaction (yellow-brown to reddish brown or even purplish brown) in Melzer's Reagent. Korf's (1973: 298) suggestion that this reaction might be useful at the generic rank is not confirmed by our studies; Raschle appears to be correct in accepting such a character only at the species level. No explanation for the differences in reactivity among species has yet been advanced.

We also concur with Raschle's (1977) treatment in not placing any emphasis at the generic level in the tribe Hyaloscypheae on whether or not the ascus pore mechanism blues in iodine (Melzer's Reagent). Raschle routinely pretreated with KOH to determine whether or not the pore blues; he did not report on whether such pretreatment changed any of the reactions he observed. We have found that pretreatment with KOH is necessary to observe the J+ reaction in *Unguiculella rehmii* (which we now treat as *Urceolella hamulata*, see below), but does not prove to be necessary in Arendholz's (1979) unpublished species that we would also refer to *Urceolella* subg. *Hyalacrotes*.

CONCLUSION

For glassy-haired Hyaloscypheae many generic names are available, but we are now convinced that according generic rank to taxa delimited by slight differences in wall thickening or degree of curvature of the hairs, or by whether or not the fungi occur as mycoparasites, obscures rather than elucidates relationships. We propose to reduce three generic names to subgeneric rank, not fully convinced that these subgenera delimit natural groups, but at least offering some leads back to the older literature where species we will include have been given generic rank in previous treatments. The following key will serve to distinguish the three genera that we accept, and their included subgenera.

Following the key we provide the full citations to the accepted genera and subgenera, and to their types.

KEY TO THE GENERA AND SUBGENERA OF GLASSY-HAIRED HYALOSCYPHEAE

1. Hairs losing glassiness when pretreated with KOH, hair walls not dextrinoid in Melzer's Reagent. **Urceolella** 2

2. Hairs with thick walls and a thin, continuous lumen (rarely lacking in some hairs) that often expands again at the hair apex; paraphyses without glassy apices. **Urceolella** subg. **Urceolella**

2'. Hairs and at least some paraphyses with solid apices and tubular, hooked or sinuous "processes" without a lumen. **Urceolella** subg. **Hyalacrotes**

1'. Hairs retaining glassiness after KOH pretreatment, dextrinoid or not. 3

3. Glassiness confined to delicate, mostly 1.0–1.5µm wide, usually branched "processes" from the excipular cells, not dextrinoid. **Mollisina**

3'. Glassiness in distinct (only very rarely branched) hairs at least 2.0µm broad, dextrinoid or not. **Hyalopeziza** 4

4. Paraphyses without hooked apices. 5

5. Hairs with thick walls, with a narrow lumen nearly to the apex, with or without thin septa, dextrinoid in some of the species. **Hyalopeziza** subg. **Hyalopeziza**

5'. Hairs with a solid apex and lumen only at the base. 6

6. Hairs uncinate, walls not dextrinoid; on fungi. **Hyalopeziza** subg. **Unguiculariopsis**

6'. Hairs straight or slightly crooked, walls dextrinoid or not; usually on plant debris. **Hyalopeziza** subg. **Unguicularia**

4'. Paraphyses and hairs with thickened, hooked, glassy apices, neither dextrinoid. **Hyalopeziza** subg. **Unguiculella**

ACCEPTED GENERA AND SUBGENERA AND THEIR TYPES

1. HYALOPEZIZA Fuckel, Jahrb. Nassauischen Vereins Naturk. **23-24:** 297. 1870, **char. emend.**

Lectotype: Hyalopeziza ciliata Fuckel, loc. cit., p. 298.

1a. HYALOPEZIZA Fuckel subg. **HYALOPEZIZA**

Lectotype: Hyalopeziza ciliata Fuckel, loc. cit.

1b. HYALOPEZIZA Fuckel subg. **UNGUICULARIA** (Höhn.) Korf & Kohn, **comb. et stat. nov.**

Basionym: Unguicularia Höhn. [ut gen.], Ann. Mycol. **3:** 404. 1905.

Holotype: **Hyalopeziza unguiculata** (Höhn.) Korf & Kohn, **comb. nov.** = Unguicularia unguiculata Höhn., loc. cit.

1c. HYALOPEZIZA Fuckel subg. **UNGUICULARIOPSIS** (Rehm) Korf & Kohn, **comb. et stat. nov.**

Basionym: Unguiculariopsis Rehm [ut gen.], Ann. Mycol. **7:** 401. 1909.

Holotype: **Hyalopeziza ilicincola** (Berk. & Br.) Korf & Kohn, **comb. nov.** = Peziza ilicincola Berk. & Br., Ann. Mag. Nat. Hist., Ser. 3, **7:** 457. 1861.

1d. HYALOPEZIZA Fuckel subg. **UNGUICULELLA** (Höhn.) Korf & Kohn, **comb. et stat. nov.**

Basionym: Unguiculella Höhn. [ut gen.], Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, **115:** 1281. 1906.

Holotype: **Hyalopeziza hamulata** (Feltg.) Korf & Kohn, **comb. nov.** = Pezizella hamulata Feltg., Vorst. Pilz-Fl. Luxembourg, Nachträge **3:** 51. 1903.

2. MOLLISINA Höhn., Mitt. Bot. Inst. TH Wien **3:** 67. 1926.

Holotype: Mollisina rubi Höhn. [ut "(Rehm) Höhnel n. sp."], loc. cit.

3. URCEOLELLA Boudier, Bull. Soc. Mycol. France **1:** 119. 1885, **char. emend.**

Lectotype: *Urceolella* *crispula* (Karst.) Boud., Hist. classific. discomyc. Europe 130. 1907.

3a. URCEOLELLA Boudier subg. **URCEOLELLA**

Lectotype: *Urceolella* *crispula* (Karst.) Boud., loc. cit.

3b. URCEOLELLA Boudier subg. **HYALACROTES** Korf & Kohn, **subg. nov.**

Holotype: **Urceolella hamulata** (Rehm) Korf & Kohn, **comb. nov.** = *Mollisia* *hamulata* Rehm *in* Rabenh., Krypt.-Fl. Deutschl., ed. 2, 1(3)[Lief. 36]: 534. 1891. = *Unguiculella* *rehmii* E. Müller, Sydowia **21:** 148. 1968 ('1967'). = *Unguiculella* *rehmii* Raitv., Scripta Mycol. **1:** 38. 1970 [nom. superfl.]

Apothecia minuta, pruinosa, hymenio leviter pruinoso. Excipulum ectale hyalinum, ad basin ex textura angulari compositum, marginem versus hyphas habens; excipulum medullare ex textura intricata compositum. Pili hyalini, ab basi ad marginem apothecii procurrentes, apice plano mitra sublanceolata refractiva solida proboscem apicalem vel subapicalem hamatam vel crispatam habente praedito, mitra una cum probosce, refractivitate materiae siccae KOH soluto madefactae evanescente. Asci clavati. Ascosporae hyalinae. Paraphyses hyalinae, dimorphae: *paraphyses* *non* *capitatae* ascos aequantes vel parum excedentes, raro sympodialiter ramificantes, apice aliquando plus minusve flexo vel deformi; *paraphyses* *capitatae* similares sed ascos parum excedentes, apice clavato mitra sublanceolata refractiva solida plerumque proboscem apicalem vel subapicalem saepe hamatam habente praedito, refractivitate materiae siccae KOH soluto madefacte evanescente.

Etymology: from the Greek, **Hyalos** = glass + **Acrotes** = tip.

ACKNOWLEDGEMENTS

The authors acknowledge financial assistance of National Science Foundation grant DEB75-23557, "Discomycete Flora of Macaronesia," technical assistance of Mr. Robert Dirig, who inked the drawing, and assistance with the Latin diagnosis by Dr. William Dress (BH). We particularly wish to thank Dr. Donald H. Pfister (FH) for the loan of type materials from the von Höhnel collections, Dr. Emil Müller (ZT) for collections of Urceolella hamulata, and Dr. W.-R. Arendholz, Hamburg, for loan of a specimen of the unpublished new species referred in his thesis to Unguiculella. Dr. John M. Haines (NYS) provided much help in reviewing an early draft of this paper.

The senior author expresses particular thanks to Dr. Henry Dissing of the University of Copenhagen, and the staff of their Institut for Sporeplanter, for inviting him to spend over two months as Adjunktvikar during 1978, when this study was initiated. Their cordial reception and encouragement will long be remembered and treasured. A special word of thanks is due Dr. Peter Milan Petersen, whose exciting collections from Greenland stimulated these studies.

The junior author expresses her appreciation to the Department of Botany, Clemson University, for financial assistance in completing this study.

LITERATURE CITED

ARENDHOLZ, W.-R. 1979. Morphologisch-taxonomische Untersuchungen an Blattbewohnenden Ascomyceten aus der Ordnung der Helotiales. Ph.D. thesis, Universität Hamburg. 115 p., 16 pl.

BØHLER. H.C. 1974. Taxonomical studies on some Norwegian Helotiales (Ascomycetes) on fern remains. Norwegian J. Botany **21**: 79-100.

DENNIS, R.W.G. 1949. A revision of the British Hyaloscyphaceae with notes on related European species. Mycol. Pap. **32**: 1-97.

_____. 1950. New fungi. Kew Bull. **1950**: 170.

_____. 1955. An overlooked species of Unguiculella. Kew Bull. **1955**: 136.

_____. 1960. British Cup Fungi and their Allies. Ray Society, London.

_____. 1968. British Ascomycetes. Cramer, Lehre.

_____. 1978. British Ascomycetes, ed. 2. Cramer, Vaduz.

HÖHNEL, F. von. 1905. Mykologische Fragmente. Ann. Mycol. **3**: 402-409.

_____. 1906. Revision von 292 der von J. Feltgen aufgestellten Ascomycetenformen auf Grund der Originalexemplare. Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, **115**: 1189-1327

_____. 1918. Fragmente zur Mykologie. (XXII. Mitteilung, Nr. 1092 bis 1153). Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, **127**: 549-634.

_____. 1926. Über die Gattung Pezizella Fuckel. Mitt. Bot. Inst. TH Wien **3**: 54-80.

KOHN, L.M. and R.P. KORF. 1975. Variation in Ascomycete iodine reactions: KOH-pretreatment explored. Mycotaxon **3**: 165-172.

KORF, R.P. 1973. Discomycetes and Tuberales. In Ainsworth, G.C., F.K. Sparrow & A.S. Sussman [eds.], The Fungi: an Advanced Treatise **4A**: 249-319.

MÜLLER, E. 1968. Neufunde von Hyaloscyphaceae aus den Alpen. Sydowia **21**: 143-153. '1967.'

NANNFELDT, J.A. 1976. Iodine reactions in ascus plugs and their taxonomic significance. Trans. Brit. Mycol. Soc. **67**: 283-287.

RAITVIIR, A. 1970. Synopsis of the Hyaloscyphaceae. Scripta Mycol. **1**: 1-115.

RASCHLE, P. 1977. Taxonomische Untersuchungen an Ascomyceten aus der Familie der Hyaloscyphaceae Nannfeldt. Sydowia **29**: 170-236. '1976.'

SVRČEK, M. 1978. New or less known Discomycetes. IX. Česká Mykol. **32**: 202-204.

AUTHOR INDEX, VOLUME TEN

ADAMS, P. B., *see* UECKER *& al.*

ALFIERI, S. A., JR. *Kutilakesa pironii* sp. nov., a stem gall- and canker-inciting fungus, new to the United States 217-218

ANAGNOSTAKIS, SANDRA L., *see* ANDERSON & ANAGNOSTAKIS

ANDERSON, JOHN F. & SANDRA L. ANAGNOSTAKIS. Validation of *Entomophthora aquatica* 350

AYERS, W. A., *see* UECKER *& al.*

BARR, MARGARET E. Additions to the Diaporthales 213-216

BAU, YUN-SUN, *see* LIU & BAU

BEN-ZE'EV, ISRAEL, & ROBERT G. KENNETH. *Zoophthora erinacea* sp. n. (Zygomycetes: Entomophthoraceae), a fungal parasite of aphids 219-232

BERGER, E. G., *see* WASSER & BERGER

CARMICHAEL, J. W., *see* SIGLER *& al.*

CHAPMAN, S. W., *see* MITCHEL *& al.*

CIBULA, WILLIAM G. Fungi of the Gulf Coast I. Two new species of *Hygrophorus* section *Hygrocybe* 105-115

CUMMINS, GEORGE B. Annotated, illustrated, host index of Sonoran Desert rust fungi 1-20

CUMMINS, G. B., *see* GILBERTSON *& al.*

DARNALL, ELIZABETH D., *see* GILBERTSON *& al.*

DICOSMO, FRANK. *Pocillopycnis,* an emendation 288-292

DUNN, M. T., *see* PUNUGU *& al.*

ESSLINGER, THEODORE L. Studies in the lichen family Physciaceae. V. Two species of *Physcia* new to North America 210-212

FARR, M. L., *see* MITCHEL *& al.*

GALLAGHER, J. E., *see* GHOSH *& al.*

GAUR, P. K., *see* SIGLER *& al.*

GHOSH, GOURI RANI, *see* MOHANTY & GHOSH

GHOSH, GOURI RANI, G. F. ORR, A. C. PIER & J. E. GALLAGHER. Comparative ascospore morphology of certain strains of *Rollandina* by scanning electron microscopy 21-28

GILBERTSON, R. L., *see* MARTIN & GILBERTSON

GILBERTSON, R. L., G. B. CUMMINS & ELIZABETH D. DARNALL. Indexes to W. G. Solheim's Mycoflora Saximontanensis Exsiccata 49-92

GRAY, DENNIS J. & G. MORGAN-JONES. Notes on Hyphomycetes. XXXIV. Some mycoparasitic species 375-404

GREENLEAF, MARK A. & RICHARD P. KORF. *Mollisia* in Macaronesia: an exercise in frustration 459-472

GUPTA, N. N., *see* MISRA *& al.*

HJORTSTAM, KURT & EVEN HØGHOLEN. Notes on Corticiaceae (Basidiomycetes) VI. *Rogersella eburnea* nov. spec. 265-268

HJORTSTAM, KURT & LEIF RYVARDEN. Notes on Corticiaceae (Basidiomycetes) V 201-209

HJORTSTAM, KURT & LEIF RYVARDEN. Studies in tropical Corticiaceae (Basidiomycetes) I 269-287

HØGHOLEN, EVEN, *see* HJORTSTAM & HØGHOLEN

JENG, R. S., *see* KRUG & JENG

JENKINS, DAVID T. A study of *Amanita* types III. Taxa described by W. A. Murrill 175-200

JENKINS, DAVID T. A new species of *Amanita* 296-298

KENNETH, ROBERT G., *see* BEN-ZE'EV & KENNETH

KOHN, LINDA M., *see* KORF & KOHN

KORF, RICHARD P., *see* GREENLEAF & KORF

KORF, RICHARD P., *see* OUELLETTE & KORF

KORF, RICHARD P. & LINDA M. KOHN. Revisionary studies in the Hyaloscypheae. I. On genera with "glassy" hairs 503-512

KRUG, J. C. & R. S. JENG. *Rhytidospora* and *Pteridiosperma*, gen. nov. (Melanosporaceae) 41-45

LATA, KANCHAN, *see* MISRA *& al.*

LIBERTA, ANTHONY E. Notes on the genus *Subulicystidium* 409-412

LICHTWARDT, R. W., *see* SIGLER *& al.*

LIU, BO & YUN-SUN BAU. A new genus and a new species of Clathraceae 293-295

LU, K. C., *see* ROSSMAN & LU

MARTIN, K. J. & R. L. GILBERTSON. Synopsis of wood-rotting fungi on spruce in North America: III 479-501

MISRA, P. C., N. N. GUPTA & KANCHAN LATA. A new species of *Fennellomyces* (Mucorales) 251-254

MITCHEL, D. H., S. W. CHAPMAN & M. L. FARR. Notes on Colorado fungi IV: Myxomycetes 299-349

MOHANTY, RATNAKAR & GOURI RANI GHOSH. Comparative physiology of some strains of *Rollandina* 29-36

MORGAN-JONES, G. Notes on Hyphomycetes. XXXV. *Stenellopsis* gen. nov. 405-408

MORGAN-JONES, G., *see* GRAY & MORGAN-JONES

MORGAN-JONES, G. & ROBERT C. SINCLAIR. Notes on Hyphomycetes. XXXIII. *Stachybotrys sphaerospora* sp. nov. from South Africa 372-374

ORR, G. F., *see* GHOSH *& al.*

OUELLETTE, G. B. & RICHARD P. KORF. Three new species of *Claussenomyces* from Macaronesia 255-264

PALM, MARY E., ELWIN L. STEWART & AMY Y. ROSSMAN. *Pithomyces funiculosa* sp. nov. from fungal comb of *Macrotermes ukuzii* in Swaziland 246-250

PATRICK, W. W., JR. Comparative morphology and taxonomic disposition of *ebulbosus*, *quadrifidus*, and *variegatus* in the genus *Coprinus* (Agaricales) 142-154

PETERSEN, RONALD H. Notes on mycological history. II. Some disbursements of Schweinitz's fungi 37-40

PIER, A. C., *see* GHOSH *& al.*

PUNUGU, A., M. T. DUNN & A. L. WELDEN. The peniophoroid fungi of the West Indies 428-454

RAJAK, R. C. Two new species of *Cercospora* 455-458

REDHEAD, SCOTT A. *Physalacria subpeltata* sp. nov. from Hawaii 46-48

ROSE, SHARON L. & JAMES M. TRAPPE. Three new endomycorrhizal *Glomus* spp. associated with actinorrhizal shrubs 413-420

ROSSMAN, AMY Y. *Absconditella duplicella* and *Cryptodiscus rutilus:* additions to the Ostropalean fungi 365-368

ROSSMAN, AMY Y., *see* PALM *& al.*

ROSSMAN, AMY Y. & K. C. LU. Filamentous fungi associated with leaf surfaces of red alder and Douglas fir seedlings in western Oregon 369-371

RYVARDEN, LEIF, *see* HJORTSTAM & RYVARDEN

SEIFERT, KEITH A. *Blistum musae:* a new species of synnematal hyphomycete 233-240

SHERWOOD, MARTHA A. Phacidiales Exsiccati Decades I-III 241-245

SIGLER, L., P. K. GAUR, R. W. LICHTWARDT & J. W. CARMICHAEL. *Renispora flavissima*, a new Gymnoascaceous fungus with tuberculate *Chrysosporium* conidia 133-141

SINCLAIR, J. B., *see* YEH & SINCLAIR

SINCLAIR, ROBERT C., *see* MORGAN-JONES & SINCLAIR

SPIELMAN, LINDA J. *Cytospora* vs. *Cytispora:* which is correct? 473-478

STEWART, ELWIN L., *see* PALM *& al.*

TRAPPE, JAMES M., *see* ROSE & TRAPPE

UECKER, F. A., W. A. AYERS & P. B. ADAMS. *Teratosperma oligocladum*, a new hyphomycetous mycoparasite on sclerotia of *Sclerotinia sclerotiorum*, *S. trifoliorum*, and *S. minor* 421-427

VAN DE BOGART, FRED. The genus *Coprinus* in western North America, Part III: Section *Atramentarii* 155-174
WALKER, CHRISTOPHER. *Complexipes moniliformis:* a new genus and species tentatively placed in the Endogonaceae 99-104
WASSER, S. P. & E. G. BERGER. Analysis of the basidium of higher basidiomycetes on the basis of geometrical dependencies 351-364
WELDEN, A. L., *see* PUNUGU *& al.*
WOLFE, CARL B., JR. *Mucilopilus*, a new genus of the Boletaceae, with emphasis on North American taxa 116-132
YEH, C.-C. & J. B. SINCLAIR. Conidium ontogeny and morphology of *Cercospora kikuchii* 93-98

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PUBLICATION DATES FOR MYCOTAXON

Volume 9, No. 2: July 19, 1979*
Volume 10, No. 1: October 19, 1979

*[the date given on the cover of Vol. 10, No. 1 is *incorrect*]

INDEX TO FUNGOUS AND LICHEN TAXA, VOLUME TEN

This index includes genera, infrageneric taxa, species, and infraspecific taxa. New taxa are in **boldface** as are the pages where they are published. The Solheim Exsiccata paper (pp. 49-92) is itself a pair of indices, reference to which is indicated by the notation "see."

Absconditella 366; duplicella 365-367; sphagnorum 366
Absidia spinosa 50
Acaulospora 102
Acremonium 45, 236; strictum 370; verticillatum 386
Acrospermum graminum 243
Acrostalagmus fungicola 402
Adelopus balsamicola 50
Aecidium **see** 50
Agaricus 390; bisporus 402
Agyrium rufum 243
Ajellomyces capsulatus 133, 136, 139, 140
Albugo **see** 50; bliti 49
Aleurodiscus 208
Alternaria **see** 50; alternata 370
Amanita 106, 175, 200, 296, 380; sect Lepidella subsect Solitariae stirps Cinereoconia 298; abruptiformis 176; alliacea 176; anisata 177; cinereoconia v cinereoconia 298; v croceescens 298; cylindrisporiformis 177; flavivolva 179; fraterna 180; griseofarinosa 298; inodora 189; lutescens 298; maculans 181; malodora 181; mappa v tenuipes 182; margarita 182; murrilliana 180; muscaria 50; mutabilis 192; neglecta 183; odorata 298; odorifera 184; **pallidoflavescens** **296**-298; pantherina 185; v pantherinoides 185, 186; pantherinoides 184; parva 185; parviformis 185; praegemmata 186; praegraveolens 182, 187; praelongispora 187; pseudoverna 188; rhoadsii 188; v flavotingens 178; roanokensis 198; f inodora 189; roseitincta 189; solitariiformis 190; spreta v minor 194; spretella 190; suballiacea 191; subcitriniceps 191; submutabilis 192; subphalloides 192; subrecutita 193; subsolitaria 193; subvirginiana 194; tenuifolia 195; umbrinidisca 195; vernella 196; verniformis 196; vestita 298; virginiana 197; virosiformis 197; watsoniana 198; wellsii 198; westii 199
Amanitopsis 175; floridana 179
Amauroascus 30; kuehnii 29
Amaurochaete atra 307, 341; ferruginea 307, 341; fuliginosa 341
Amphinema 428; byssoides 431, 434
Amphisphaeria separans 50
Amyloathelia 201, 202, 204, 209; **amylacea** **202**-204, 206; **crassiuscula** 201, **204,** 205
Amylocorticium 201, 209; **laceratum** 205, **206**
Amylostereum 208, 209, 491; chailletii 491
Anthostomella ratibidae 50
Anthracoidea eleocharidis 50
Apioplagiostoma aceriferum 213; carpinicolum 213
Apiosporella alpina 50
Apiosporina collinsii 50
Arachniotus 28, 139; dankaliensis 28; hyalinosporus 22; marginosporus 22; reticulatus 29
Arcyodes incarnata 303, 315
Arcyria 238, 317, 318; cinerea 303, 315; denudata 303, 316; ferruginea 303, 316; globosa 303, 316; incarnata 303, 316, 317; insignis 303, 317; nutans 303, 317; oerstedtii 303, 317; olivaceoglobosa 303, 317; pomiformis 303, 317; punicea 316; stipata 303, 317; versicolor 303, 317; vitellina 317
Armillaria mellea 50
Armillariella 498; mellea 498
Arnoldia 375, 378; **clavispora** 375, **376**-378
Arthrinium arundinis 370
Arthroderma multifidum 140; tuberculatum 140
Ascochyta **see** 50
Aspergillus clavatus 370; niger 370
Asperisporium peucedani 50
Asterodon 484; ferruginosus 484
Asteroma tennerimum 50
Asterostroma 487, 488; andinum 488; cervicolor 488
Athelia 202, 204
Athelopsis 206; glaucina 207; lembospora 201, 205-207
Aureobasidium pullulans 369, 370
Auricularia 480; auricula-judae 50; auricularis 480

Badhamia affinis 305, 330; capsulifera 305, 330; dearnessii 305, 330; decipiens 337; foliicola 305, 331; gracilis 305, 331; macrocarpa 305, 331; nitens 305, 331; obovata 333; orbiculata 330; ovispora 305, 331; panicea 305, 331; v heterospora 332; populina 305, 332; rubiginosa 333; utricularis 305, 332; versicolor 306, 332
Badhamiopsis ainoae 306, 332
Basidiophora entospora 50
Bifusella **see** 51; linearis 242

Blastotrichum puccinioides 380
Blistum 233, 234, 236, 238-240; **musae** 233, **234,** 236, 238; orbiculare 233, 234, 236, 238; ovalisporum 236; tomentosum 236
Boletellus violaceiporus 122, 127, 129, 131, 132
Boletus **see** 51, 352, 386, 388, 392; conicus 118-120, 123; v conicus 122; felleus 116; porphyrosporus 116
Boreostereum 491; radiatum 491
Botrytis cinerea 370; variospermum 382
Bourdotia 481; eyrei 481
Brevicellicium 269; exile 271; **mellinum 269-271**.

Caldesia sabina 51
Calomyxa metallica 302, 315
Calonectria 365; duplicella 365; rutila 366
Calvatia cyathiformis 51
Cantharellus cibarius 51
Ceraceomyces 271
Ceratiomyxa fruticulosa 301, 310; mucida 310
Cercoseptoria **see** 51
Cercospora **see** 51, 93, 455, 457; **amaryllicola** 455, **457**, 458; kikuchii 93-96; **pentasii 455-457**
Ceriomyces conicus 120
Chaetendophragmia 424; triangularia 426; triseptata 426
Chaetomium cochlioides 370; elatum 370; funicolum 370
Chlorociboria 255-257; **salviicolor** 255, **257**
Chlorosplenium salviicolor 256, 257
Chondrostereum 491; purpureum 491
Chrysomyxa **see** 51
Chrysosporium 133, 134, 139, 140
Ciborinia confundens 51
Cicinnobolus major 51
Cienkowskia reticulata 306, 332
Cintractia **see** 51
Circinella 251; linderi 251
Cladobotryum 375, 378; apiculatum 378, 381; dendroides 378; mycophilum 378, 380, 382, 384; variospermum 382; varium 378, 382, 385; verticillatum 370, 382, 386, 387
Cladosporium 405; cladosporioides 370; fulvum 408; herbarum 370; macrocarpum 370; ornithogali 405; oxysporum 370; sphaerospermum 370
Clathrus 293, 294; columnatus 293
Claussenomyces 255-257, 259, 262; atrovirens 261, 263; **canariensis** 255, **257,** 259, 260, 263; **clavatus** 255, 257, **259,** 261, 263; **dacrymycetoideus** 255, 257, **259,** 262, 263; jahnianus 255, 262; luteoviridus 256, 257, 263; prasinulus 263; pseudotsugae 262; pusillus 262; salviicolor 256
Clavariadelphus 482; ligula 482
Claviceps purpurea 51
Clitocybe infundibuliformis 51
Coccomyces 242, 244; coronatus 242; delta 243; dentatus 243; irretitus 244; leptideus 242; quadratus 242; strobi 243; tumidus 242
Coleosporium **see** 51-52
Coleroa **see** 52
Collybia 499; acervata 499
Columnocystis 490, 492; abietina 492, ambigua 492
Comatrichia 342; aequalis 307, 341; alpina 308, 341; elegans 308, 341; fimbriata 308, 342; irregularis 308, 342; laxa 308, 342; nigra 308, 342; v aequalis 341; v suksdorfii 342; nodulifera 308, 342, 343; persoonii 342; pulchella 308, 342; rubens 308, 342; suksdorfii 308, 342, 343; typhina 343; typhoides 308, 342
Complexipes 99, 102, 103; **moniliformis 99,** 100, 103, 419
Conidiobolus 229
Coniophora 482, 483; arida 483; corrugis 52, 483; flava 440; fusispora 483; puteana 483
Coniophorella 483; olivacea 483
Coniothyrium concentricum 52
Coprinus 142, 144, 151, 155; sect Atramentarii 150; 155-157; sect Lanatuli 150; sect Picacei 149; "group" Picacei 142; "tribe" Tomentosi 150; atramentarius 142, 143, 150, 154, 156, 172, 173; v acuminatus 157, 172, 173; v atramentarius 157, 169, 170, 173; v **crassivelatus** 155, 157, **173,** 174; comatus 142, 143; **depressiceps** 155, 157, **165,** 166; ebulbosus 142-144, 147, 149, 151, 152; picaceus 149-151; v ebulbosus 149, 152; **pinguisporus** 155, 157, **161,** 162; quadrifidus 142-144, 147, 149-152; soboliferus 169; **striatus** 155, 157, **158,** 159; variegatus 142-144, 147, 149-152, 154
Coriolus versicolor 378, 380
Corticium 271; amylaceum 201, 202, 204; byssinum 52; carneum 435; cerinum 287; cinereum 435; citrinellum 453; confusum 207; cremeum 436; filamentosum 438; inconspicuum 453; laceratum 201, 206; lembosporum 206, 207; mellinum 269; mutatum 454; roumegueri 446; sambuci 450; simile 451; subalutaceum 451; subochraceum 271, 272; sulphurosum 271; tenue 451; tephrum 454; versicolor 452
Cortinarius **see** 52
Corynascus sepedonium 140
Corynella 255
Crandallia juncicola 52
Craterium aureum 306, 332; leucocephalum 306, 332; v cylindricum 333; v rufum 333; v scyphoides 333; minutum 306, 333; obovatum 306, 333
Crepidotus 496; ramosus 497
Cribraria 240, 312; argillacea 301, 310; atrofusca 301, 310; aurantiaca

[Cribraria aurantiaca] 301, 310; elegans 301, 310; intricata 301, 311; macrocarpa 301, 311; microcarpa 301, 311; minutissima 301, 311; oregana 301, 311; piriformis 301, 311; purpurea 301, 311; pyriformis 311; rufa 301, 311; violacea 301, 312; vulgaris 301, 312
Cronartium **see** 52
Cryptodiscus 366, 367; rutilus 366, 367
Cryptosporella 214, 215
Ctenomyces serratus 29, 30
Culicicola 229
Cumminsiella **see** 52
Curvularia lunata 370
Cylindrocarpon obtusisporum 370
Cylindrophora apiculata 378
Cylindrosporium **see** 52-53
Cystostereum 490; murraii 490; piceinum 490
Cytispora 473-477
Cytospora **see** 53, 473-477

Dacrymyces 261, 474, 480; abietinis 481; ellisii 480; palmatus 481; punctiformis 481
Dacryomyces 474
Dactylium mycophilum 380; varium 382
Darluca filum 53
Dasyscypha **see** 53
Dendrodontia 269, **273**; **bicolor 273**, 274
Dendrothele 204, 208
Diachea 310; leucopodia 304, 323; subsessilis 304, 323
Dianema corticatum 302, 315; depressum 302, 315; harveyi 302, 315; subretisporum 302, 315
Diatrype albopruinosa 53
Dibotryon morbosum 53
Dicarpella 214; bina 215; georgiana 215; **quercifolia 215**
Dictydiaethalium plumbeum 302, 314
Dictydium 238; cancellatum 301, 312; v alpinum 312; mirabile 301, 312
Diderma 323, 324; alpinum 325; asteroides 304, 323; brooksii 304, 323, 324; chondrioderma 304, 324; cor-rubrum 304, 324; crustaceum 304, 324; effusum 304, 324; evelinae 323; floriforme 304, 324; globosum 304, 324; hemisphaericum 304, 324; lyallii 304, 324; michelii 324; montanum 304, 325; niveum 304, 325, 326; radiatum 304, 326; roanense 304, 326; sauteri 304, 326; spumarioides 304, 326; stellare 326; testaceum 304, 326; trevelyanii 304, 325, 326
Didymaria **see** 53
Didymium 238, 327, 328; anellus 305, 326; anomalum 329; clavus 305, 326; crustaceum 305, 327; decipiens 305, 327; difforme 305, 327; dubium 305, 327-329; eximium 328; farinaceum 328; fulvum 305, 327; megalosporum 305, 328; minus 305, 328; nigripes 305, 328; nivicolum 305, 328, 329; quitense 305, 328; squamulosum 305, 329; sturgisii 305, 329
Didymobotryopsis cerastii 53
Didymosphaeria clementsii 53
Dimerosporium collinsii 53
Dinemasporium 370
Diplocladium elegans 380
Discella pilosula 53
Discina ancilis 53
Discocainia treleasei 243
Doassansia alismatis 53
Duplicaria acuminata 53
Durella atrocyanea 244

Echinodontium 483; tinctorium 483
Echinostelium elachiston 302, 315
Emericella nidulans 370
Emericellopsis 45; stolkiae 53
Emmonsiella capsulata 133
Endogone 417; eucalypti 103; multiplex 417
Endophyllum tuberculatum 53
Enerthenema berkeleyanum 308, 343; melanospermum 308, 343, 344; papillatum 308, 343, 344; syncarpon 343
Enteridium lycoperdon 302, 314; olivaceum 302, 314; rozeanum 314; splendens 302, 314; v jurana 302, 314
Entomophaga 229
Entomophthora 227, 229, 230; subg Triplosporium 229; aphidis 221, 227; **aquatica 350**; fresenii 220; montana 219; muscae 230; occidentalis 231; parvispora 230; planchoniana 220; turbinata 222, 226, 229
Entyloma **see** 53
Epicoccum purpurascens 370
Erysiphe **see** 53-54
Eupropolella vaccinii 242
Exidia **see** 54
Exidiopsis 481; calcea 481; macrospora 482
Exobasidium **see** 54

Fabraea maculata 54
Fabrella tsugae 242
Fennellomyces 251; linderi 251, 254; **heterothallicus 251**, 252, 254
Fibricium 490; rude 490
Flammulina 499; velutipes 499
Fomes **see** 54
Foveostroma 288; drupacearum 288
Fulgine 238
Fuligo 238; cinerea 306, 333; ellipsospora 333; intermedia 306, 333; megaspora 306, 334; septica 306, 334
Fulvia 408; fulva 408
Fusarium arthrosporioides 370; tabacinum 370
Fusicladium depressum 54

Ganoderma applanatum 54; tornatum 411
Gasterocybe lateritia 54
Gelasinospora tetrasperma 370
Gelatinopycnis 288

Gelatinosporium 289, 291, 370
Geniculisporium 370
Geomyces 139
Geopyxis cupularis 54
Gigaspora 102, 103, 419; heterogama 102; margarita 419; rosea 419
Gloeocystidiellum 208
Gloeosporium **see** 54, 370
Glomus 102, 103, 413, 417; albidus 417; caledonius 415; clarus 417, 419; etunicatus 99; fasciculatus 99, 417; **halonatus 413,** 415; **lacteus 415**–417; microcarpus 417; monosporus 415, 417; mosseae 417; multicaulis 417; pallidus 419; **scintillans 417,** 419
Grandinia bicolor 269, 273; rosea 281
Guepiniopsis alpinus 54
Gymnoascus reessii 29, 30; uncinatus 29
Gymnoconia ridelliae 1, 16
Gymnosporangium **see** 54–55

Hadrotrichum **see** 55
Haematostereum 491; sanguinolentum 491
Hapalocystis 214; **corni 214;** ulmi 214
Harknessia 215; americana 215
Helicobasidium 480; corticioides 480
Helminthosporium 474, 476
Helmisporium 474, 476
Helvella infula 55
Hemiarcyria 238
Hemiphacidium planum 55
Hemitrichia 318; abietina 303, 318; calyculata 303, 318; clavata 303, 318; karstenii 303, 318; montana 303, 318; ovata 318; serpula 303, 319; stipitata 318
Hendersonia calamovilfae 55
Hericium 484; abietis 484
Herpobasidium deformans 55
Herpotrichia nigra 55
Heterodictyon 312
Heterosporium **see** 55, 405; magnoliae 405, 406, 408; ornithogali 405
Heterotextus 480; alpinus 480
Histoplasma 133
Holwaya 255
Humicola fuscoatra 370
Hyalopeziza 503, 504, 508, 509; subg **Hyalopeziza** 503, 508, **509;** subg **Unguicularia** 508, **509;** sung **Unguiculariopsis** 508, **508;** subg **Unguiculella** 508, **509;** ciliata 509; **hamulata 509; ilicincola 509;** millepunctata 506; **unguiculata 509**
Hyalopsora polypodii 55
Hyalotricha 504
Hydnum eichelbaumii 275; imbricatum 55
Hygrocybe 105, 112; mexicana 105, 108
Hygrophorus 111, 112; subg Hygrocybe 111; sect Hygrocybe 105; appalachianensis 111; calophyllus 55; cantharellus 109; **chamaeleon** 105, **109,** 113; firmus 108, 109; v trinitensis 105, 108; **mississippiensis** 105, **106,** 113
Hymenella 39
Hymenochaete 484, 485; cinnamomea 485; fuliginosa 485; tabacina 485; tenuis 485
Hyphoderma 267, 269, 428; argillacea 432, 433; odontiaeforme 279; piliseta 432, 445; praetermissum 277; **rude 275,** 276; setigera 432, 434; tenuis 432, 451
Hyphodontia 267, 428; mutatum 454; subalutacea 432, 451
Hypochnella 209
Hypochnicium 202
Hypochnus dussii 438; longisporus 443
Hypoderma saccatum 55
Hypomyces aurantius 382; dactylarius 400; ochraceus 400; odoratus 380, 400; paconius 400; rosellus, 378, 400; semitranslucens 392, 396; tulasneanus 375, 378, 388, 389
Hypoxylon pruinatum 55

Inonotus 484, 485; circinatus 485; dryadeus 485; tomentosus 485
Intextomyces 269, 279; contiguus 279; **umbrinus** 277, **279**
Irpicodon 208

Kabatia **see** 55
Kellermannia **see** 55
Khuskia oryzae 370
Kneiffia brasiliensis 278, 279
Kunkelia nitens 55
Kutilakesa 218; circinosetifera 217; madreeya 217; **pironii 217**

Lachnellula chrysophthalma 55
Lachnobolus 240; congestus 315
Lactarius 380, 386; deliciosus 55
Laestadia quercifolia 215
Laeticorticium 273
Lamproderma 300, 346; arcyrioides 308, 344; atrosporum 308, 344; carestiae 308, 344; columbinum 308, 345; cribrarioides 308, 345; cristatum 308, 345; echinosporum 308, 345; fuscatum 308, 346; gulielmae 308, 346; maculatum 308, 346; sauteri 308, 346; scintillans 308, 346; violaceum 344; v carestiae 345
Lasiobolus pilosus 55
Lasiobotrys lonicerae 55
Lasiostictis fimbriata 243
Laurilia 208, 484; sulcata 484
Laxitextum 208
Lentinellus 498, 499; montanus 499; omphalodes 499
Lentinus 396, 498, 499; kauffmanii 499; lepideus 499
Lenzites betulina 400; saepiaria 55
Leocarpus fulvous 334; fragilis 306, 334.
Lepidoderma 325; carestianum 305, 329; chailletii 305, 329; granuliferum 305, 330; tigrinum 305, 330

Lepiota praegraveolens 187
Leptoderma iridescens 308, 346
Leptosporomyces ovoideus 271
Leptothyrium **see** 55
Leucogyrophana mollis 209; subillaqueta 209
Leucomyces mexicanus 199
Leucostoma 475, 476
Licea 300; belmontania 301, 312; castanea 301, 313; fimicola 301, 313; flexuosa 313; kleistobolus 302, 313; minima 302, 313; parasitica 302, 313; tenera 302, 313; variabilis 302, 313
Lindbladia 238; effusa 312; tubulina 301, 312
Linodochium 288
Lophionema apoclastospora 55
Lophodermella **see** 55
Lophodermium arundinaceum 243; decorum 55, 242; pinastri 244; tumidum 242; uncinatum 244
Luellia 207
Lycogala epidendrum 302, 314; flavofuscum 302, 314
Lysurus 293, 294; mokusin 293

Marasmius 400
Margarita metallica 315
Marssonia **see** 55
Marssonina **see** 56
Massariovalsa 214
Massospora 229
Mastigosporella 215; hyalina 215
Melampsora, 12, **see** 56; lini 12, 15; paradoxa 12, 18
Melampsorella **see** 56-57
Melanconiella corni 214
Melanconiopsis 214
Melanconis 213; sect Thelebolae 213; corni 213, 214
Melanconium 370
Melasmia imitans 57
Melzericium 202, 209
Memnoniella echinata 370
Metatrichia vesparium 303, 319
Microsphaera **see** 57
Microsporum 28
Microthecium 41, 42, 44; ciliatum 41, 42, 45; foveolatum 41, 42, 44, 45; hypomyces 41; inordinatum 41, 44
Mollisia 459, 460, 463, 464, 467, 468, 481; cinerea 460, 462, 467, 472; **dextrinospora** 459, 461, **462**, 464, 471; fallens 462, 471, 472; hamulata 504, 510; melaleuca 460, 462; melaleucoides 460; trabincola 462, 464, 471; ventosa 462
Mollisina 503, 504, 506, 508, 509; rubi 506, 509
Monochaeta 370
Monocillium 370
Monodictys 370; castaneae 370
Mortierella ramanniana v angulispora 370
Mucilago crustacea 305, 330; spongiosus 330
Mucilopilus 116, **117-119**, 122, 124, 126, 127, 129, 130; sect **Mucilopilus 118**; sect **Scrobiculati 118**, 119; **conicus** 116, **119**, 123; v **conicus 119**, 120, 122, 127; v **reticulatus** 116, 119, **121**, 122, 126, 127; **nothofagi 126**; **venezuelae 127**; **violaceiporus 129**; **viscidus 130**; v **macrosporus 124**
Mucor 251, 253
Mucronella 484; aggregata 484
Mycoacia 281
Mycoaciella 269, 281; bispora 281; **hinnulea** 280, **281**
Mycobanche chrysosperma 392; rosea 390
Mycogone 375; perniciosa 378, 388, 391; psilocybina 375; puccinioides 380; rosea 378, 390, 393; verticillata 386
Mycosphaerella **see** 57
Myriophacidium amphyophyllicum 242
Myxotrichum uncinatum 29

Naematoloma 500; capnoides 500
Nannizzia 23
Narasimhella 22, 139; hyalinospora 22, 23; poonensis 21-24, 26, 30
Nectria cinnabarina 57
Nectriella pironii 217
Nematogonium 240
Neopeckia coulteri 57
Neurospora sitophila 370
Niptera 459, 462
Nodulisporium 370
Nyssopsora **see** 57

Odontia hinnulea 281; rudis 275
Oidium ambrosiae 57
Oligonema fulvum 303, 319; schweinitzii 303, 319
Ophiobolus festucae 57
Orcadella pusilla 313
Ovularia **see** 57

Panellus 498, 499; serotinus 500; stipticus 500
Passalora **see** 57
Penicillium 370; spiculisporum 29
Peniophora 428, 429; affinis 432; argillacea 433; aspera 432, 433; burtii 434; byssoides 434; carnea 429, 435; cinerea 429, 435, 454; citrinella 453; cremea 436; dussii 438; filamentosa 438; flammea 443; flava 431, 440; flavido-alba 432, 439, 440; galochroa 285, 453; gracillima 441; hiulca 441; inconspicua 453; inflata 430, 441; longispora 409, 410, 443; v brachyspora 410; ludoviciana 432, 443; mutata 454; nikau 409, 410; phosphorescens 445; piliseta 445; pruinata 454; ralla 409; ravenelii 432, 446, 447; roumegueri 432, 446, 448; sacchari 432, 446, 449; sambuci 450; septocystidia 450; seymouriana 454;

[Peniophora] similis 432, 451; subalutacea 451; tenuis 451; tephra 454; versicolor 429, 452; versiformis 429, 452, 454
Perichaena chrysosperma 303, 319; corticalis 303, 319, 322; depressa 303, 320; vermicularis 303, 320
Peridermium **see** 57
Peronospora **see** 57-58
Pestalotia clavispora 370; microspora 370; vaccinii 370
Petalosporus 139
Peziza 39; ilicincola 509
Pezizella hamulata 509
Phakopsora 12; crotonis 8, 12
Phanerochaete 271, 287, 428; affinis 430, 432; burtii 430; cremea 431, 436; filamentosa 430, 438, 439; **hiulca** 430, **441**; **phosphorescens** 431, **445;** septocystidia 431, 449, 450
Phellinus 484, 486; chrysoloma 487; ferreus 487; ferrugineofuscus 486; ferruginosus 486; nigrolimitatus 486; pini 487; repandus 487; robustus 487; viticola 486; weirii 486
Phialophora 460-462, 464; fastigiata 462; hoffmannii 370; verrucosa 370, 459, 462
Phlebia 269, 281, 282; queletii 281; romellii 268; **rosea 281,** 282
Phlebiopsis 269, 285; **galochroa** 283, **285;** gigantea 285
Phleospora **see** 58
Pholiota 496, 497; adiposa 497; alnicola 497; aurivella 497; bakerensis 497; decorata 497; limonella 497
Phoma glomerata 370; herbarum 370
Phragmidium **see** 58
Phragmodothis conspicua 59
Phragmopyxis 7, **see** 59; acuminata 8; noelii 7, 8
Phyllachora **see** 59
Phyllactinia corylea 59
Phyllosticta **see** 59
Physalacria 46, 48; sect Pileolina 48; **subpeltata 46,** 47
Physalospora 214, 215; astragali 59, quercifolia 214, 215
Physarum 323, 324, 339; albescens 306, 323, 334; alpinum 306, 335; auriscalpium 306, 335; berkeleyi 337; bethelii 306, 335; bitectum 306, 335, 337; bivalve 306, 335; bogoriense 306, 335; brunneolum 306, 336; carneum 306, 336; cinereum 306, 336; citrinum 306, 336; compactum 340; compressum 306, 336; conglomeratum 306, 336; connatum 339; contextum 306, 336, 337; v mortonii 339; decipiens 306, 334, 337; diderma 306, 337; didermoides 306, 337; famintzinii 307; 337; flavicomum, 307, 337; globuliferum 307, 337; gyrosum 307, 337; lateritium 307, 338; leucophaeum 307, 338; leucopus 307, 338; listeri 307, 338; luteoalbum 338; luteolum 307, 338; maydis 339; megalosporum 307, 338; melanospermum 338; mortonii 307,339; nephroideum 336; newtonii 307, 339; notabile 307, 339; nudum 307, 339; nutans 307, 339; v leucophaeum 338; oblatum 307, 339; pallidum 336; polycephalum 307, 339; pulcherrimum 307, 340; pusillum 307, 340; rubiginosum 307, 340; stellatum 307, 340; straminipes 335, 337; sulphureum 307, 340; superbum 307, 340; testaceum 337; vernum 307, 340; virescens 307, 341; viride 307, 335, 341; v bethelii 335
Physcia 210-212; albicans 211; crispa 211; dimidiata 210, 211; dubia 211; grisea 211; magnussonii 210-212; tribacia 211
Physconia 211; grisea 211
Physoderma **see** 59
Pileolaria **see** 59
Pithomyces 246, 248; **funiculosa 246-249;** graminicola 248
Plagiostoma 213; acerophilum 213; alneum 213; v betulinum 213; bavaricum 213; campylostylum 213; v mirabile 213; devexum 213; euphorbiis 213; inclinatum 213; magnoliis 213; micromegalum 213
Plasmopara **see** 60
Pleuroceras groenlandicum 213; helveticum 213; pleurostylum 213; tenellum 213
Pleurotus 498; ostreatus 498; sapidus 402
Pluteus 501; cervinus 501
Pocillopycnis 288, 289; umensis 288, 289, 291
Podosphaera oxyacanthae 60
Polyporus **see** 60, 398; varius 396
Polystigma astragali 60
Polythrincium trifolii 60
Porphyrellus 116-118; sect Porphyrellus 116, 117; sect Pseudotylopili 116, 117; sect Scrobiculati 118; conicus 120; nothofagi 122, 124, 126, 128; porphyrosporus 116, 117; violaceiporus 127; viscidus 116, 117, 122, 126, 129-131; v macrosporus 122-125, 132; v viscidus 124
Prospodium 17; appendiculatum 17, 18
Prosthecium subg Pseudoprosthecium 214
Protophysarum phloiogenum 307, 340
Prototrichia flagellifera 320; metallica 303, 320, 327
Psathyrella 151
Pseudoarachniotus hyalinosporus 21-24; 26, 27, 30; marginosporus 21-26, 30; punctatus 21-25, 28, 30; roseus 28
Pseudocenangium 288
Pseudoclathrus 293; cylindrosporus 293, **294,** 295
Pseudographis elatina 243
Pseudogymnoascus 139; roseus 139
Pseudohydnum 481; gelatinosum 481
Pseudomassaria 214; quercifolia 215
Pseudopeziza **see** 60

Pseudoplectania nigrella 60
Pseudotomentella 493; humicola 493; mucidula 493; nigra 493; umbrina 493
Pseudoxenasma 208
Pteridiosperma 41, **44,** 45; **ciliata** 41, **45**; **foveolata** 41, **45**
Puccinia 7, 9, 12, 14, 17, **see** 60-67; abrupta 17, 20; acroptili 8, 9; anisacanthi 3, 7; antirrhini 3, 20; arechavaletae 6, 9; aristidae v chaetariae 3, 7; asparagi 5, 20; baccharidis 5, 7; blasdalei 3, 9; cacabata 5, 7, 11; calcitrapae v centaureae 6, 20; californica 8, 9; canaliculata 2, 8, 9; cnici-oleracei 3, 9; confraga 13, 14; convolvuli 8, 20; cumminsii 2, 5; cynodontis 8, 12; dietelii 3, 8, 9; diplachnis 6, 12, 13; distorta 13, 14; enceliae 17, 20; eupatorii 10, 12; evadens 5, 7; franseriae 3, 7, 13; giliae 10, 12; globosipes 14, 15; graminis 15, 20; grindeliae subsp grindeliae 11, 14; subsp **riddelliae** 1, 14, **16;** guillemineae 6, 9; helianthi 11, 17; heterospora 2, 7; hieracii v harknessii 17, 18; hydrocotyles 11, 12; invaginata 11, 12; invelata 14, 16; leptochloae 1, 12, 13, 18; lithospermi 11, 12; lobata 14, 15; malvacearum 3, 20; megalospora 12, 13; nodosa 10, 12; obliqua 14, 18; ocellifera 16, 17; oenotherae 6, 9; pelargonii-zonalis 16, 20; praetermissa 13, 14; purpurea 18, 20; recondita 20; schedonnardi 14, 15; sherardiana 17, 18; sonorae 3, 7; sonorica v sonorica 3, 7; sorghi 20; splendens 13, 14; subnitens 9, 10; tanaceti v tenaceti 8, 20; tetramerii 14, 20; turgidipes 1, 17, 20; tuyutensis 8, 12; velata 9, 10; vexans 6, 9, 11; xanthii 17, 20
Pucciniastrum **see** 67
Punctularia 489; strigosozonata 489
Pyrenopeziza 459
Pyrenophora phaeospora 67

Radulodon 269, 287; **subquercinus** 284, **285,** 287
Radulum subquercinum 285; umbrinum 279
Ramularia **see** 67-68
Ravenelia 5, **see** 68; arizonica 5, 16; bajacalensis 5, 15; epiphylla 5, 18; expansa 2, 5; fragrans v evernia 5, 15; v fragrans 15; humphreyana 5, 6; lysilomae 5, 15; mesillana 5, 6; piscidiae 5, 16; pringlei 2, 5; scopulata 2, 5; spinulosa v papillifera 5, 6; thornberiana 2, 5
Renispora **133,** 139; **flavissima** **133,** 134, 136, 139, 140
Reticularia lycoperdon 314
Rhabdocline pseudotsugae 68; weirii subsp obovata 243
Rhabdogloeum pseudotsugae 68
Rhizopus 371
Rhytidospora 41, 42, 44; **bispora** 41, **42-44**; **inordinata** 41, 43, **44**; tetraspora 41-44
Rhytisma **see** 68; acerinum 243
Robergea albicedrae 242; nigra 242
Rogersella 267, 268, 428; asperula 267, 268; **eburnea** **265**-268; sambuci 267, 268, 432, 450
Rollandina 21-23, 28-30; capitata 21, 22, 24, 29, 30, 32, 34; hyalinospora 21-24, 29, 30, 32, 34
Russula 380, 386; emetica 386

Scaphidium boutelouae 68
Schizonella melanogramma 68
Schizophyllum 498; commune 498
Sclerocystis 102
Sclerotinia 421, 423; caricis-ampullaceae 69; minor 421-424; sclerotiorum 421, 422, 424; trifoliorum 421-423
Sclerotium bifrons 69
Scolecotrichum graminis 69
Scopulariopsis asperula 371; brevicaulis 371; brumptii 371
Scytalidium lignicola 371
Scytinostroma 208, 273, 487, 488; arachnoideum 488; galactinum 488
Scytinostromella 208, 287; **cerina** 286, **287;** humifaciens 287
Secotium agaricoides 69
Selenophoma 371; donacis 69
Selenosporella 421-426; verticillata 426
Sepedonium 140; chrysospermum 392; mycophilum 375, 378, 392, 394; roseum 390
Septogloeum **see** 69
Septonema chaetospira 371
Septopatella 288
Septoria **see** 69
Sepultaria aurantia 69
Serpula 482; hiamantioides 482
Shanorella 139
Sibirina 375, 396; fungicola 392, 395, 396, 398, 400; **gamsii** 375, **396**-398, 400; orthospora 396, 398; **purpurea** 375, **398**-400
Siroscyphella 288
Smithiomyces 200
Sordaria fimicola 371; minima 371
Sorosporium **see** 69
Sparassis 489; crispa 489; radicata 489
Sphacelotheca **see** 69
Sphaeria duplicella 365
Sphaeroderma hypomyces 41
Sphaerotheca **see** 69
Sporidesmium 421; sclerotivorum 421, 424, 426; subulatum 424, 426
Sporonema punctiforme 70
Spumaria alba 330; v solida 330
Stachybotrys 372; chartarum 372, 374; microspora 374; nilagirica 374; **sphaerospora** **372**-374
Stagonospora **see** 70
Steccherinum 281, 490; ciliolatum 490
Stemonitis 240; axifera 308, 346; confluens 308, 347; ferruginea 346;

[Stemonitis] flavogenita 309, 347; fusca 309, 347; v fusca 347; v papillosa 347; v rufescens 347; herbatica 309, 347; hyperopta 309, 347; nigrescens 309, 347; smithii 309, 347; splendens 309, 347; v confluens 347; uvifera 309, 348; virginiensis 309, 348
Stenella 405, 408
Stenellopsis 405, 408; **magnoliae 406-408**
Stephanosporium ceralis 371
Stereum **see** 70, 208, 400, 491; hirsutum 491; pruinatum 454; versiforme 452
Stictis ostropoides 244; radiata 242; v aggregata 244
Stilbella 233, 238; orbicularis 236
Stilbospora 214
Stilbum 233; orbiculare 236, 238
Strongwellsea 229
Subulicystidium 409-411, 428; brachysporum 409-411; **cochleum** 431, **436,** 437; longisporum 409-411, 431, 443, 444; meridense 410, 411; naviculum 410, 411; nikau 410, 411
Suillosporium 482; cystidiatum 482
Suillus 118; conicus 120
Syncarpella tumefaciens 70
Synchytrium **see** 70

Talaromyces luteum 371
Tapesia 459
Taphrina **see** 70
Teichospora negundinis 70
Teratosperma 422-426; **oligocladum** 421, **422**-424, 426; singulare 426
Thelephora 492; aspera 433; byssoides 434; caryophyllea 70; setigera 434; terrestris 492
Therrya fuckelii 242
Tilletia **see** 70
Titaeospora detospora 70
Tomentella 493; atrorubra 495; avellanea 496; bresadolae 495; bryophila 495; calcicola 493; chlorina 493; cinerascens 494; lateritia 494; nitellina 494; ochracea 496; olivascens 496; ramosissima 496; rubiginosa 495; ruttneri 495; sublilacina 496; subvinosa 494; terrestris 494
Tomentellastrum 492; floridanum 492
Tomentellina 492; fibrosa 492
Torula herbarum 70
Trametes **see** 70
Tranzschelia **9, see** 70; cohaesa 3, 9
Trechispora byssinella 271
Tremella 481; mesenterica 481
Trichia 238; affinis 322; alpina 303, 321; botrytis 303, 321; contorta 303, 321; v attenuata 322; v inconspicua 321; decipiens 303, 322; v decipiens 322; v olivacea 322; fallax 322; favoginea 303, 322; flavicoma 321; floriformis 304, 322; lutescens 304, 322; persimilis 322; scabra 304, 322; subfusca 304, 323; varia 304, 323
Trichocladium asperum 371
Tricholomopsis 498, 500; decora 500; rutilans 500; streetsii 500
Trichothecium roseum 371, 378
Triplosporium 229, 230; fresenii 220
Tryblidiopsis 244; pinastri 244
Tryblidium alpinum 243
Tuberculina persicina 70
Tubifera ferruginosa 302, 314
Tubulicrinis 428; gracillima 430, 441, 442
Tubulina cylindrica 314
Tulasnella 482; pruinosa 482; violea 482
Tylopilus 116-118; sect Scrobiculati 118; conicus 120; venezuelae 122, 126-128, 132
Tympanis 256; confusa 256; pseudotsugae 256
Typhulochaeta japonica 70

Ulocladium botrytis 371; chartarum 371
Uncinula salicis 70
Unguicularia 503-505, 507, 509; millepunctata 506; unguiculata 509
Unguiculariopsis 503, 504, 509
Unguiculella 503-505, 509, 511; hamulata 504, 505; rehmii 504-507, 510, 511
Urceolella 503-506, 508, 510; subg **Urceolella** 503, 506, 508, **510;** subg **Hyalacrotes** 503, 506-508, **510;** crispula 510; **hamulata** 505, 507, **510,** 511
Uredinopsis **see** 70
Uredo mycophila 392
Urocystis agropyri 70
Uromyces 17, 19, **see** 70-72; appendiculatus 16, 19; beloperones 5, 19; betae 5, 20; compactus 5, 19; eragrostidis 10, 19; euphorbiae 11, 19; giganteus 18, 19; indigoferae 13, 19; intricatus 10, 19; limonii 13, 19; ornatipes 16, 17; punctatus 5, 19; setariae-italicae 10, 19; shearianus 5, 17; socius 17, 18; sonorensis 15, 19; striatus 15, 20; tranzschelii 11, 19; viciae-fabae 49
Urophlyctis pluriannulatus 72
Uropyxis 5; daleae v eysenhardtiae 5, 11; nissoliae 5, 16
Ustilago **see** 72

Vaginata 175
Valsa 475, 476; nivea 72
Vararia 487, 488; athabascensis 489; granulosa 488; investiens 489; racemosa 489
Varicosporium 371
Venenarius 175; abruptiformis 176; alliaceus 176; anisatus 177; cylindrisporiformis 177; flavescens 178; fraternus 180; gemmatus v volvatus 180; maculans 181; malodorus 181; mappa v tenuipes 182; margarita 182; odoriferus 184; pantherinoides 184;

[Venenarius] parviformis 185; parvus 185; praegemmatus 186; praelongisporus 187; pseudovernus 188; rhoadsii 188; roanokensis f inodora 189; roseitinctus 189; solitariiformis 190; spretellus 190; suballiaceus 191; subcitriniceps 191; submutabilis 192; subphalloides 192; subrecutitus 193; subsolitarius 193; subvirginianus 194; tenuifolius 194; umbrinidiscus 195; vernellus 196; verniformis 196; virginianus 197; virosiformis 197; watsonianus 198; wellsii 198; westii 199
Verticillium 236, 388, 390, 396, 398; fungicola 375, 400, 402, 403
Vesiculomyces 208

Xenasma 428; dussii 430, 438
Xenasmatella 209
Xeromphalina 498; campanella 498
Xerulina asprata 411
Xylobolus 208

Zoophthora 226, 227, 229, 230; subg Erynia 226, 227, 229, 230; subg Pandora 227, 230; subg Zoophthora 227, 230, 231; aphidis 220, 221, 227; **erinacea** 219, 222, 224, 226, **227**, 230, 231; montana 219, 226; occidentalis 231

ERRATA, VOLUME NINE

Page 370, line 8: *for* delim- *read* delimit

ERRATA, VOLUME TEN

10(1) *Cover*,	line 57:	*for* July 13, *read* July 19,
Page 7,	line 3:	for *sonorica* read *sonorica* v. *sonorica*
29	29-30:	*for* kuehnii) (Kuehn) *read* kuehnii
50	46:	*for* ANTHROCOIDEA *read* ANTHRACOIDEA
108	34:	for *H.* read *Hygrophorus*
120	16:	*for* var. *conicus* (Rav. *apud* B. & C.) Wolfe. *read* (Rav. *apud* B. & C.) Wolfe var. *conicus*.
122	37:	for *B. violaceiporus* read *Boletellus violaceiporus*
126	13:	for *B. violacei-* read *Boletellus violacei-*
140	31:	for *A. tuberculatum* read *Arthroderma tuberculatum*
178	28-29:	*for* 285-579. *read* 499.
185	17:	for *Amanit* read *Amanita*
189	3:	*for* f. *inodora* (Coker) Murrill *read* (Coker) Murrill f. *inodora* Murrill
193	23:	for *Amanits* read *Amanita*
202	23:	for *Hyphochicium* read *Hypochnicium*
204	9:	for *A. amylacea* read *Amyloathelia amylacea*
207	35:	*for* characteristica *read* characteristics
234	37-39:	*substitute* Figure 1: A-F B. musae IMI 235790 A) Synnema B) terminal ornamentations C) lateral ornamentations D) conidia E) lateral phialide with developing conidium F) terminal phialides
236	13:	*insert* 174318 *between* material *and* in
243	43:	for *gaminum* read *graminum*
290	18:	for *P.* read *Pocillopycnis*
370	35:	for *Gliosporium* read *Gloeosporium*
392	10:	for *chrysosperma* read *chrysospermum*
408	20:	for *Cladosporium fulva* read *Cladosporium fulvum*
423	39:	for *S.* read *Sclerotinia*
428	13:	*for* eight *read* nine
	14:	after *(6)*, insert *Rogersella (1)*,
430	47:	for HUILCA read HIULCA
433	9:	for *P.* read *Peniophora*
436	32:	for *cremea* read *cremeum*

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